DOCUMENT RESUME

ED 270 355 SO 017 163

AUTHOR Tan, Jee Peng; Haines, Michael
TITLE Schooling and Demand for Children: Historical Perspectives. World Bank Staff Working Papers, No. 697 and Population and Development Series, No. 22.
INSTITUTION World Bank, Washington, D. C.
REPORT NO ISBN-0-8213-0450-X
PUB DATE 84
NOTE 124p.; For related documents, see SO 017 156-157, SO 017 161-162, SO 017 164, SO 017 192.
AVAILABLE FROM Publications Sales Unit, Department T, The World Bank, 1818 H Street, N.W., Washington, DC 20433.
PUB TYPE Reports - Research/Technical (143)

EDRS PRICE MF01 Plus Postage. PC Not Available from EDRS.
DESCRIPTORS Attrition (Research Studies); *Birth Rate; Demography; Developed Nations; Developing Nations; Enrollment Projections; *Enrollment Trends; *Trend Analysis

ABSTRACT

The schooling of children, thought to be an important factor in explaining changes in fertility over time, is examined. Theory predicts that it exerts a negative effect on parental fertility. The mechanisms by which this relationship occurs at the micro-level are elaborated by Becker in this quantity-quality trade-off model, and by Cadwell in his intergenerational transfer model. The results of empirical studies are mixed, with some studies finding positive, others negative, and still others no relationship between quantity and quality. This paper extends the existing discussion by evaluating the evidence from a historical perspective. The time-series data for 5 developed countries and 18 developing countries suggest that, prior to the attainment of primary gross enrollment ratios of about 70 or 80 percent, there appears to be little relationship between levels or change in primary school enrollments and fertility. Evidence suggests that a fairly high level of educational development, as indicated by the level of primary enrollment, seems to be important for a decline in fertility to take place. Costs and financing arrangements, and parental aspirations for children's education may be an important reason behind the observed historical relationship. Numerous tables and an 11-page bibliography are included. (RSL)

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Schooling and Demand for Children

Historical Perspectives

Jee Peng Tan
Michael Haines

WORLD BANK STAFF WORKING PAPERS
Number 697

POPULATION AND DEVELOPMENT SERIES
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Washington, D.C., U.S.A.

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First printing November 1984

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Library of Congress Cataloging in Publication Data

Tan, Jee Peng, 1954-
Schooling and demand for children.

(World Bank staff working papers ; no. 697)
Bibliography: p.
1. Fertility, Human--Economic aspects. 2. Fertility, Human--Economic aspects--Developing countries. 3. Education--Demographic aspects. 4. Education--Demographic aspects--Developing countries. I. Haines, Michael R. II. Title. III. Series.
HB901.T36 1984 304.6'32 84-26944
ISBN 0-8213-0450-X

FOREWORD

This paper is one in a special series of World Bank Staff Working Papers on population change and development. Prepared as background papers for the World Development Report 1984, they provide more detailed treatment and documentation of the issues dealt with in Part II of the Report. The papers cover a range of topics, including the effects of population growth and change on economic development, the determinants of fertility and mortality, the links between population growth and internal and international migration, and the management, financing, and effectiveness of family planning programs. They include several country and regional studies of fertility change and population policy.

The background papers draw on a large number of published and unpublished studies of individual researchers, on Bank policy analysis and research, and on reports of other organizations working on population and development programs and issues. The papers are the work of individuals and the views and interpretations expressed in them do not necessarily coincide with the views and interpretations of the Report itself.

I hope these detailed studies will supplement the World Development Report 1984 in furthering understanding of population and development issues among students and practitioners of development.

Nancy Birdsall
Staff Director
World Development Report 1984

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Summary

This paper focuses on one of the factors thought to be important in explaining changes in fertility over time, namely the schooling of children. Theory predicts that it exerts a negative effect on parental fertility. The mechanisms by which this relationship occurs at the micro-level have been elaborated by Becker in this quantity-quality trade-off model, and by Caldwell in his intergenerational transfer model. In the Becker model, an increase in quantity decreases demand for quality, both through the shadow income constraint, and by raising the shadow price of quality. An increase in the demand for quality decreases the demand for close quantity by a similar mechanism. Although quantity and quality need not be close substitutes, an increase in the demand for one will decrease the demand for the other. In the Caldwell model, fertility decline sets in only when the direction of net wealth flow changes from children to parents, over to parents to children. The (mass) education of children is seen as a primary determinant in changing the direction of the wealth flow between generations. First, the child's potential for work both inside and outside the family is reduced; not only because of the hours needed for school attendance and homework, but also because of the changing attitudes of the child and family toward traditional work at home. Second, education increases the direct costs of children to the family. The institution of mass education also changes the position of the child in the family and in society, and accelerates cultural change and the creation of new (western middle-class) cultural values.

The results of empirical studies are mixed, with some studies finding positive, others negative, and still others no relationship between quantity and quality. This paper extends the existing discussion by evaluating the evidence from a historical perspective. The time-series data for five presently developed countries and eighteen developing countries show that, prior to the attainment of primary gross enrollment ratios of about 70 or 80 percent, there appeared to be little relationship between levels or change in primary school enrollments and fertility. There were exceptions, but overall a fairly high level of educational development, as indicated by the level of primary enrollments, seemed to be important for a decline in fertility to take place.

It is suggested in this paper that costs and financing arrangements, and parental aspirations for children's education may be important reasons behind the observed historical relationship. At early stages of development, parental aspirations are likely to be low, so that for most children parents desire only a few years of primary schooling. At this level of education, the costs, both direct and indirect, are also low. Moreover, the social organization in traditional societies is likely to be such that parents do not expect to bear the full cost of their children's schooling since they can usually rely on relatives and even older children for financial support. As a society modernizes, however, the inverse relationship between child schooling and parental fertility is likely to become stronger. The high level of primary school enrollments characteristic of such societies is probably symptomatic of

rising returns to education, which implies a corresponding rising pay-off to investment in child quality. Parents are likely to plan for more years of education for their children, including possibly secondary and even higher education. This is likely to imply an escalating economic burden, since the opportunity cost of children's education at the post-primary ages is substantially higher than at the younger ages. Also, as the process of development often weakens kinship ties and sibling obligations, the cost of financing schooling is likely to fall more fully on parents.

Acknowledgements

We are grateful to Nancy Birdsall, Rodolfo Bulatao, Dennis DeTray and William McGreevey for their comments on an earlier draft. We alone are, however, solely responsible for the views expressed in this paper.

Résumé

Cette étude examine un des facteurs qui, croit-on, contribue largement à expliquer les variations de la fécondité, à savoir la scolarisation des enfants. Selon la théorie, elle exerce un effet négatif sur la fécondité des parents. Les mécanismes de cette causalité ont été précisés par Becker dans son modèle d'interaction entre la quantité et la qualité et par Caldwell dans son modèle de transfert intergénérationnel. Dans le modèle de Becker, une augmentation de la quantité amène une diminution de la demande de qualité, en comprimant le revenu virtuel et en accroissant le prix virtuel de la qualité et une augmentation de la demande de qualité amène une diminution de la demande de quantité. Bien que la quantité et la qualité ne soient pas exactement des produits substituables, lorsque la demande d'un de ces facteurs augmente, celle de l'autre diminue. Selon le modèle de Caldwell, la fécondité ne baisse que lorsque la direction du flux net de richesses (des enfants aux parents) s'inverse (pour aller des parents aux enfants). L'enseignement (de masse) des enfants est considéré comme un facteur déterminant dans le renversement de la direction de ce flux entre les générations. Premièrement, le potentiel de travail de l'enfant, tant à l'intérieur qu'à l'extérieur de la famille, diminue; cela ne tient pas simplement au fait que l'enfant doit passer un certain nombre d'heures à l'école et à faire ses devoirs, mais également à une modification de la manière dont l'enfant et la famille envisagent le travail traditionnel à la maison. Deuxièmement, l'éducation augmente le coût direct de l'enfant pour la famille. L'éducation de masse modifie la place de l'enfant dans la famille et dans la société, accélère le changement culturel et la création de nouvelles valeurs culturelles de la classe moyenne occidentale.

Les résultats d'études empiriques ne sont pas probants, certaines études concluant qu'il existe un rapport positif, d'autres un rapport négatif, d'autres encore aucun rapport entre la quantité et la qualité. La présente étude reprend la question en examinant les données dans un contexte historique. Les données de séries chronologiques de cinq pays développés et de dix-huit pays en développement montrent que tant que les ratios bruts d'inscription à l'école primaire n'ont pas atteint 70 ou 80 %, il ne semble guère y avoir d'interaction entre les niveaux d'inscription à l'école primaire et la fécondité. Il y a des exceptions mais dans l'ensemble, il semble que le développement de l'éducation (exprimé par le taux d'inscriptions primaires) doive avoir atteint un niveau relativement élevé avant qu'on puisse noter une baisse de la fécondité.

D'après cette étude, il semblerait que l'on peut, dans une grande mesure, expliquer ces phénomènes par le coût de l'enseignement des enfants, les modalités de son financement et les aspirations des parents.

Pendant les premiers stades du développement, les aspirations des parents sont en général relativement modestes, ce qui fait qu'ils ne souhaitent, dans la plupart des cas, que quelques années d'enseignement primaire. A ce niveau d'instruction, les coûts directs et indirects sont faibles. En outre, la structure sociale des sociétés traditionnelles est en général telle que les parents n'ont pas à supporter tout le coût de l'éducation de leurs enfants. Ils peuvent obtenir un soutien financier de leur famille et même de leurs enfants plus âgés. Néanmoins, à mesure que la société se modernise, il est probable que le rapport inverse entre l'éducation des enfants et la fécondité parentale se renforce. Le fort niveau d'inscriptions dans les écoles primaires, qui est caractéristique de ces sociétés, est probablement symptomatique de la rentabilité accrue de l'éducation, qui implique une augmentation proportionnelle des bénéfices de l'investissement dans la qualité des enfants. Les parents envisagent d'étendre la scolarité de leurs enfants, peut-être de les envoyer à l'école secondaire ou même à l'université. Il en résultera un fardeau économique plus élevé, puisque le coût d'opportunité de l'enseignement des enfants est sensiblement plus élevé une fois qu'ils ont dépassé l'âge de l'école primaire. Comme, en même temps, le processus de développement affaiblit souvent les liens familiaux et les obligations entre frères et soeurs, une partie plus importante du coût du financement de l'éducation retombe sur les parents.

Resumen

El presente estudio se centra en uno de los factores que se consideran importantes a la hora de tratar de explicar las variaciones en la fecundidad a través del tiempo, a saber, la educación de los hijos. La teoría sostiene que ésta ejerce un efecto negativo en la fecundidad de los padres. Los mecanismos por los cuales esa relación tiene lugar en el micronivel han sido estudiados detalladamente por Becker en su modelo de las compensaciones recíprocas entre cantidad y calidad, y por Caldwell en su modelo de las transferencias intergeneracionales. En el modelo de Becker, un aumento de la cantidad hace que disminuya la demanda de calidad, tanto a través de la limitación del ingreso de cuenta como a través del aumento del precio de cuenta de la calidad. Un aumento de la demanda de calidad reduce la demanda de cantidad por medio de un mecanismo análogo. Aunque no es preciso que la cantidad y la calidad se sustituyan entre sí exactamente, todo aumento de la demanda de una hará que disminuya la demanda de la otra. En el modelo de Caldwell, la disminución de la fecundidad se produce sólo cuando el sentido de la corriente neta de patrimonio, de los hijos hacia los padres, se invierte y va de los padres hacia los hijos. La educación (universal) de los niños se considera un factor determinante primario del cambio de sentido de la corriente patrimonial entre las generaciones. En primer lugar, las posibilidades del niño para trabajar dentro y fuera del ámbito familiar se reducen, no sólo debido a la cantidad de horas necesarias para asistir a la escuela y estudiar en la casa, sino también debido a la evolución de las actitudes del niño y de la familia con respecto al trabajo tradicional en el hogar. En segundo lugar, la educación incrementa los costos directos de los hijos para la familia. La institución de la educación universal, hace que cambie la posición que el niño ocupa en la familia y en la sociedad, y acelera el cambio cultural y la generación de nuevos valores culturales (de la clase media occidental).

Los resultados de estudios empíricos han sido diversos: en algunos han sido positivos, en otros negativos y en otros se ha hallado que no hay ninguna relación entre la cantidad y la calidad. En este trabajo se amplía el análisis en curso evaluando las pruebas desde una perspectiva histórica. Los datos de las series cronológicas elaboradas para cinco países actualmente desarrollados y 18 países en desarrollo indican que antes de alcanzarse coeficientes brutos de matrícula primaria de alrededor de 70% u 80% parecía existir poca relación entre los niveles o las variaciones de la matrícula escolar primaria y la fecundidad. Había excepciones, pero, en términos generales, para que se produjera una disminución de la fecundidad parecía ser importante lograr un grado bastante elevado de desarrollo educacional, tal como el indicado por el alto nivel de la matrícula primaria.

En el presente estudio se señala que los costos y los mecanismos de financiamiento, así como las aspiraciones de los padres con respecto a la educación de sus hijos, pueden ser razones importantes de la relación histórica observada. En las etapas iniciales del desarrollo es probable que las aspiraciones de los padres sean modestas, de modo que, en lo que atañe a la mayor parte de sus descendientes, los padres sólo deseen unos pocos años de educación primaria. A este nivel, los costos, tanto directos como indirectos, son también pequeños. Más aún, es probable que la organización social de las sociedades tradicionales sea tal que los padres no esperan tener que sufragar el costo total de la educación de sus hijos, ya que generalmente pueden recurrir a los parientes e incluso a los hijos mayores para obtener apoyo financiero. A medida que una sociedad se moderniza, sin embargo, es probable que la relación inversa entre la educación de los hijos y la fecundidad de los padres se refuerce. El alto coeficiente de la matrícula escolar primaria característico de esas sociedades probablemente sea síntoma de un rendimiento creciente de la educación, que a su vez supone una rentabilidad creciente de la inversión en la calidad de los hijos. Es probable que los padres planeen más años de educación para éstos, incluida tal vez la educación secundaria y aún la universitaria. Esto probablemente represente un aumento de la carga económica, ya que el costo de oportunidad de la educación de los hijos en edades posprimarias es mucho mayor que el de la educación de los hijos más jóvenes. Además, como el proceso de desarrollo a menudo debilita los lazos familiares y las obligaciones para con los hermanos, es probable que el costo de financiar la educación recaiga más de lleno en los padres.

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1. Introduction

The purpose of this paper is to study the relationship between the schooling of children (as opposed to that of parents) and fertility change. Some attention will be paid to mortality change, although that is more likely to be a cause than an effect of changes in children's education. There already exists a strong body of evidence which notes a negative relation of mother's education to fertility and to child mortality [Cochrane, 1979, 1980; Behm, 1979; United Nations, 1982]. The focus here will be less on differentials and more on trends over time, with attention being paid to declines in fertility and changes in school enrollment, schooling costs, compulsory schooling, costs and benefits of children and their schooling, and some other relevant factors, such as child labor laws, which affect fertility through the child.

2. Children's Schooling and Fertility Change

2.1 Preliminary Considerations

The education or schooling of children is generally regarded as an investment in human capital, or child quality [Becker, 1975, 1981; Schultz, 1981]. Associated with this investment process are direct costs (e.g., expenditures on school fees, books, supplies, subsistence costs) and indirect costs, particularly foregone earnings (opportunity cost) of the child. Benefits are to be expected. They are not so easy to measure, but would include enhanced future welfare of the child, especially because of higher wages or earnings, as well as increased income to the family, if the child contributes to the family when he or she eventually enters the labor force.

Several important questions must be approached in the course of the inquiry: Who makes schooling decisions? Who finances schooling (i.e., parents or the government)? Why would parents or children invest in child quality? What is the relationship of schooling to fertility and child mortality? What has been the historical and contemporary record on this? These topics form the basis for the present paper.

2.2 Theoretical Relationships and Supporting Evidence

The literature on the demographic transition has often mentioned education as an important aspect of the transition process [Notestein, 1954; Beaver, 1975; Coale, 1973]. Much attention has been paid to the existence of a negative relationship between parental education (especially education of the mother) and fertility [Cochrane, 1979; Graff, 1979]. Much of the empirical work has dealt with cross-sectional results, but some evidence indicates that secular change in education may influence fertility decline [Stycos, 1977]. Education of parents also appears to affect differential childhood mortality [Cochrane, 1980; United Nations, 1982; Behm, 1979].

Another aspect operates through the education process by affecting the costs and benefits of children. The fertility behavior of the parents, and possibly child mortality in their families, are influenced by the costs of educating their children and by the perceived benefits of that education [Arnold, et. al., 1975; Caldwell, 1982, ch. 10]. Schooling has been associated with modernization and the demographic transition. Ansley Coale, in his discussion of the demographic transitions, notes:

> "[A] society was modern, in 1960, if at least 50 percent of the population lived in urban settlements of more than 20,000 persons, if more than 90 percent

> of the female population at ages 6 to 13 was enrolled in school, and fewer than 30 percent of the labor force was engaged in agriculture, fishing and forestry. A society was traditional if less than 30 percent of its population lived in urban settlements of more than 20,000 persons, if fewer than 50 percent of females 6 to 13 were enrolled in school, and if more than 60 percent of the labor force was engaged in agriculture, fishing, or forestry." [Coale, 1973, p. 64]

A modern society is one with low birth and death rates and a traditional society is one with high fertility and mortality. One problem with this viewpoint is that "threshold values" of these indicators seem to have changed over time. For example, Germany and Scandinavia had very high levels of literacy by 1870, but had undergone no sustained fertility decline. Examining historical evidence, Knodel and van de Walle [1979] found no evidence of a correlation between level of literacy and the date of onset of the fertility decline.

Nevertheless, Caldwell has advanced the theory that fertility decline only sets in when the direction of net wealth flow changes from children to parents over to parents to children. "It is argued that the primary determinant of the timing of the onset of the fertility transition is the effect of mass education on the family economy. The direction of the wealth flow between generations is changed with the introduction of mass education. . . " [Caldwell, 1982, p. 301]. He cites five mechanisms for this impact of mass education on parents' fertility behavior. First, the child's potential for work both inside and outside the family would be reduced (i.e., indirect costs to the family are increased). This is not only because of hours needed for school attendance and homework, but also changing attitudes of the child and the family toward traditional work at home. Second, education increases

direct costs to the family. These costs often go beyond fees, books, uniforms and supplies into improved general levels of clothing, nutrition, etc. Third, schooling, or rather the philosophy which underlies the institution of mass education, changes the position of the child in the family and in society. Rather than being regarded as a present productive resource within the family, the child is regarded as a future productive resource by society and, eventually, by the family. The status of dependent is reinforced and increased, and society passes laws to protect children (e.g., child labor and compulsory schooling laws). Fourth, mass education accelerates cultural change and the creation of new cultural values, particularly because the working class can now be reached through their children. And finally, the schools serve as a major instrument for propagating Western middle-class values [Caldwell, 1982, pp. 303-305]. In general, the first two mechanisms (via indirect and direct costs) are widely cited; whereas education as a means of creating, changing and diffusing values and norms is often considered, but not very systematically. Caldwell indeed believes that it is the last three value-related mechanisms which are more influential in turning the family economy from one in which children are perceived as a net benefit to one in which they are seen as a net cost.

Another approach has been taken in recent years by economists who have constructed micro-economic, household decision-making models which incorporate a quantity-quality trade-off in childbearing [Becker, 1960, 1981, ch. 5; Becker and Lewis, 1973; Becker and Tomes, 1976; Willis, 1973; DeTray, 1973]. This literature draws on the notions of household production functions and human capital theory [Schultz, 1981; Becker, 1975; Michael and Becker, 1973]. In the simplest type of model [Becker, 1981, pp. 103-104], the demand

for number of children (quantity) and child quality depends both on the shadow prices of quantity, quality, and other commodities, and "shadow income". Quantity and quality (the amount of human capital) of children interact inversely in demand functions, depending upon market prices and income. That is, an increase in quantity decreases demand for quality, both through the shadow income constraint and by raising the shadow price of quality. An increase in quality decreases demand for quantity by a similar mechanism. (See Appendix A for a brief description in more formal terms.) Although quantity and quality need not be close substitutes (and indeed cannot be if the system is to be stable in a range of plausible values), an increase in demand for one will decrease the demand for the other. This offers a probable reason for historical fertility decline in developed countries.

> "Several alternative explanations for large changes in fertility have been suggested, including the contraceptive revolution ushered in by the pill. . . , but this cannot explain the large decline in births in the United States during the twenties or in Japan during the fifties. I am convinced that the most promising explanation is found in the interaction between quantity and quality of children, for it implies that the demand for children is highly responsive to price and perhaps to income, even when children have no close substitutes." [Becker, 1981, pp. 106-107]

A basic conclusion of this model is that economic development and modernization, which usually increase demand for skilled labor relative to unskilled labor, raises rates of return on education and training, especially in urban areas. This lowers the marginal cost (and hence the shadow price) of child quality. As a consequence, demand for child quality increases, which interacts with quantity to reduce fertility. In addition, reductions in child mortality can reduce the marginal cost of child quality, which can, in turn, reduce fertility via the same mechanisms (see below).

In general, the basic model can be extended to anything which reduces the costs of child quality or increase the returns, including various governmental policies such as schooling, which affect human capital investments. Becker cites evidence [1981, p. 111] that the empirical relationship between quantity and quality is usually negative, especially for developed countries. Tomes [1978], DeTray [1978] and Rosenzweig and Wolpin [1980] also found evidence for this for the contemporary United States. Rosenzweig and Wolpin [1982] demonstrate theoretically that a compulsory schooling law which forces parents to educate their children beyond a level which they would have chosen in the absence of the law will have a negative effect on fertility. In another paper, Rosenzweig notes, however, that the basic economic maximization model "cannot predict how a subsidy to health or education will influence fertility or even investments in health or schooling; it can only predict total resources allocated to children. . . will rise, since investments in both numbers and the quality of children are made cheaper by subsidization of basic needs." [Rosenzweig, 1981, p. 57] Empirical results for rural India and urban Colombia indicate, however, that health programs lowered both fertility and child mortality. "Basic needs subsidies to fertility control, to health and to schooling thus appear to have the same joint outcomes--smaller family size and more investments in each child." [Rosenzweig, 1981, p. 59]

It should be noted that this economic model can also be extended to include childhood mortality [Becker, 1981, pp. 111-112]. For example, an exogenous decline in childhood mortality caused by a public health program can free parental resources which had been devoted to child mortality prevention, while at the same time increasing the expected rate of return on child investments. This would lower the shadow price of child quality and increase

demand for child quality (and hence induce a reduction in quantity). Thus mortality decline during the demographic transition could induce greater demand for schooling. Preston [1980, pp 324-326] notes, however, that the effect of mortality decline on rates of return from education is not likely to be very large.

This model seems most appropriate for urban, high-income societies in which fertility is low or declining, and where investment per child is already high. Eva Mueller (1983) has argued that in less developed, rural societies the relationship between children's education (and child quality generally) and fertility may be only weakly negative, null, or even positive. She notes that the quantity-quality trade-off assumes tastes (preferences) as given, and also that quality is more income elastic and more price elastic than quantity. This is true only when education is assigned a great importance in the household utility function, which is a condition that is unlikely to prevail at early stages of development in rural, agrarian regions. With high child mortality and with relatively low rates of return on education, price and income elasticities of demand for child quality may be relatively low. In addition, education costs may not be substantial, even including indirect costs of foregone labor. If children are sent to school for only 3-4 years, or even the 6 years to complete primary education, the direct costs may not be especially burdensome. Further, children attending school only up to ages 11-13 are not as much missed in terms of labor or income contributions to the family as would children aged 14 and over. School years may be short (several months only) and hence children may even be able to make significant economic contributions to the family while continuing to attend school. It may be

that older siblings help pay for the direct schooling costs of younger children, and so increased demand for quality might even have a positive relationship to the demand for quality.

In general, Mueller notes that child quantity and quality could be positively related under a regime of natural fertility (e.g., if rising income might make possible both increased fertility and increased children's education), if the opportunity cost of school attendance is seen as being lower in larger than in smaller families; if net rates of return to parents from educating their children are perceived as positive; or if siblings or relatives assist in educating children. Even if the quantity-quality relation is negative, it may well be weak if the family does not accord a high priority to education and child quality.

The empirical evidence on this is mixed, with some studies finding positive, others negative, and still others no relationship between quantity and quality. Table 1 contains the results of some recent studies on the quantity-quality model of fertility. In the three African case studies listed, the relationship between number of children and per child investment is positive in five of the six regressions cited. For Botswana, Chernichovsky found that

> "The larger the number of school-age children in the household, the higher the probability of their school enrollment and the higher their levels of education. This finding can be in part explained by the falling productivity of labor in the household with any given amount of assets that reduce the indirect cost of schooling. The fall in productivity may lead to role assignment in the household; some children are kept for household and farm activities, while others are 'assigned' to school and allowed to concentrate on this activity." [Chernichovsky, 1981]

Snyder's study of Sierra Leone revealed a positive and statistically significant relationship between quantity and quality. His explanation is that

> "Tropical African parents often regard a child as an investment good, a device for attaining income security in old age, and an educated child has more earning power and hence more "social security value" than an uneducated one. Furthermore, the parents often do not bear the full cost of educating the child under the extended family system: relatives, friends, and older children sometimes chip in, expecting to reap further benefits when the child completes school and starts to earn. Either or both of these factors may cause parents to seek large families and high education per child. . ." [Snyder, 1974]

Evidence for a third African country comes from Kelly's [1980] analysis of the economic and demographic behavior of households in urban Kenya. Although his study does not deal directly with the quantity-quality trade-off question, his data and regression results offer some hints. In particular, household investment in education increases as the number of children in the household increases, but the per child investment tends to decline.[1/] In a study of India using district and village level data, Sahota and Sahota [1980] found an interesting relationship between schooling and fertility. If investment in child quality is measured simply by the enrollment rate, the relationship is positive, contrary to theory's prediction; on the other hand, if it is measured by schooling quality (proportion of non-repeaters in class), the relationship is negative. In a situation where tuition is free, out-of-pocket expenses low, and opportunities for child labor have been declining, as happened in the Punjab in the period under review, the family bears a relatively small cost to keep a child in

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1/ In all his regressions, dI_e/dC_s is statisically significant at the 5% level or above and ranges from 6.3 to 8.9 shillings, where I_e is household investment in education, and C_s the number of surviving children. At the mean of I_e, 29.3 shillings, the percentage increase in I_e corresponding to an additional surviving child is between 11 and 15 percent. Even standardizing for age and sex profiles, the per child investment in large families is likely to be lower than in smaller families.

Table 1: Some Empirical Studies of the Quantity-Quality Model of Fertility

Authors	Country	Year	Sample Characteristics	Regression Variable Definitions		Relationship between q and n	Statistical Significance
				Quantity (n)	Quality (q)		
Chernichovsky (1981)	Botswana	1974	National sample of 1,000 rural households	No. of children aged 7-14	(1) child in school dummy	+	5%
					(2) level of child education of those who stopped	-	n.a.
					(3) level of schooling of those currently enrolled	+	5%
					(4) time spent in school	+	n.a.
DeTray (1978)	USA	1967	Subsample of 1163 white households drawn from the National Longitudinal Survey	No. of children living at home and elsewhere as reported by the husband	Average educational level of children not living at home, this is assumed to be the completed level of schooling	-	5%
Snyder (1974)	Sierra Leone	1966-1968	Subsample of 717 urban households from the Western Area Household	No. of live births fathered by the household head	Educational attainment of the oldest child, $E_c - E_c$, defined as the residual for a regression of years of schooling on the child's age, i.e. the portion of the child's educational attainment not attributable to age	+	5%
Rosenzweig and Wolpin (1980)	India	1969-1971	1,633 rural households from the Additional Rural Incomes Survey of 2939 households	Multiple births per pregnancy	Age standardized schooling index		
					(1) including twins	-	n.a.
					(2) excluding twins	-	n.a.
Birdsall (1980)	Colombia	1967-1968	1433 households in 4 major cities	(1) No. of children of wife currently alive	Ratio of current actual household expenditure on education to its predicted expenditures based on sex and age of enrolled children	-	5%
				(2) Fertility measure based on children ever born standardized for the age-fertility relationship using a natural fertility schedule		+	n.a.
Sahota and Sahota (1980)	India	1964-1971	Combined time series and cross section data from 18 districts and 30 villages, yielding 75 observations at the district level; 155 at the village level	Birth rate	(1) Total school enrollment as percent of total population	+	10%
					(2) Ratio of pupils spending one year or less in a class to total pupils in the class	-	10%
					(3) mean age of pupils in various classes	-	10%
Kelley (1980)	Kenya	1968-1969	401 household mostly African nuclear from 3 urban areas (Nairobi, Kisuma and Mombassa)	No. of surviving children	Total household expenditures on education (school fees, school uniform, books, etc.)	+	10%

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school. However, the cost to the family rises as the quality of schooling desired for the child increases. Thus, one is more likely to observe a negative relationship between fertility and child investment when the latter is associated not merely with enrollment, but rather with schooling quality. However, in the study by Rosenzweig and Wolpin [1980] for another Indian sample, the negative relationship predicted by theory is borne out by the data, although it is statistically not significant. Another study by Rosenzweig [1982] found that, in India, farm households that have been exposed to the new technologies of the "green revolution" reduced fertility and increased level of schooling investment. The mere proximity of schools, in the absence of technical change, had little impact on either schooling or family size.

Birdsall [1980] presents some data for Colombia which show the inverse relationship between number of children and investment in their schooling. The result is, however, sensitive to the definition of the fertility variable. For other Latin American countries, evidence on the quantity-quality trade-off comes indirectly from Mugrove's [1977] analysis of household expenditure on education in 11 cities. In general, the share of education in total family expenditure increases as the number of children in the family increases, but the relative rates of increase imply that investment per child is probably lower in larger than in smaller families.

Evidence on the effect of educational subsidies on fertility has become available recently [Rosenzweig and Wolpin, 1982; Rosenzweig, 1982; and Rosenzweig and Schultz, 1983]. In these studies, educational subsidies are proxied by a variable indicating the presence or availability of schooling

Table 2: Share of Education in Total Family Expenditures by Family Composition in 11 Latin American Cities

	Families with children aged			No. of children in family			Percent
City	7 or less	8-18	19 or more	0	1-2	3-5	6 or more
Bogota	2.11	7.75	1.98	4.12	4.70	3.15	5.92
Barranquilla	1.95	5.44	1.74	1.85	3.41	4.17	3.65
Cali	1.40	4.17	1.51	1.73	2.24	2.91	3.84
Medellin	1.64	5.69	0.93	2.10	3.00	4.06	4.52
Santiago	0.49	1.12	0.55	0.50	0.87	0.82	0.74
Quito	0.94	2.12	0.81	0.84	1.43	1.59	1.91
Quayaquil	1.22	2.71	1.04	1.33	1.83	2.01	1.90
Azuncion	1.30	2.93	0.92	1.80	1.82	2.01	3.01
Lima	1.00	2.48	0.99	1.62	2.01	1.54	1.11
Caracas	--	--	--	2.13	3.30	4.62	3.54 /1
Maracaibo	0.93	2.35	1.01	1.16	1.81	1.49	0.58

/1 Based on less than 40 observations.

Source: (Musgrove, 1978), pp. 350-360.

facilities; this variable is a valid proxy in so far as the presence of a school, say in a village, implies a reduction in the price for schooling for that village. Presumably this price reduction is associated with reductions in the time and travel cost of attending school [Rosenzweig, 1982]. The empirical results provide partial support for a positive relationship between educational subsidies and schooling on the one hand; and a negative relationship between subsidies and fertility on the other. In other studies (see Birdsall [1982] for a partial listing) which focus more on the determinants of school attendance, the effect on attendance of educational subsidies as proxied by the same types of variables (presence of school, distance to school) turns out to be statistically insignificant in a surprisingly large number of regressions; and in some of those regressions for which the effect is statistically significant, the sign of the coefficient is negative instead of positive.

Among studies of developing countries not mentioned in Table 1, a recent monograph by Anker and Knowles [1982] looks at the quantity-quality issue for rural and urban areas in Kenya. They find that higher educational attainment is positively related to fertility in rural areas; but, in urban areas, neither enrollment rates nor wife's expectations regarding children's education had a signficiant effect on fertility. Children were evidently seen as a "good investment" in rural areas. A doctoral dissertation by Carol Clark [1979] on schooling decisions in rural Guatemala notes that there is an increase in work time and a reduction in school attendance for children when there are one or more siblings aged 15-18 in the household. Evidently, quality and quantity in this instance are negatively related; she attributes this to the lower income per capita associated with larger numbers of children

which induces greater labor supply despite the reduced opportunity cost of children's time. A study of families in the rice farming areas of central Thailand by Ron and Shutjer [1982] also finds a negative relationship between quantity and quality within a simultaneous equations framework. The income elasticity of expected children's education is also greater than the income elasticity of children born, which is also in accord with the Becker model.

The value of child studies conducted at the East-West Center, based on surveys in the U.S., the Philippines, and the Republic of Korea found that financial costs, including schooling, figured prominently in inducing couples to limit their family size [Bulatao and Arnold, 1977]. Earlier research by Eva Mueller [1972] on Taiwan, China in 1969 concluded that economic considerations associated with costs and benefits of children, rising education and income levels, and availability of new consumer goods all led to smaller family size preferences and increased use of contraception. Educational aspirations of parents for children were important.

For developed countries, the conclusion seems to be that the quantity trade-off is negative and significant. This accords with the evidence cited in Becker [1981, p. 111]. One of those studies, by Dennis DeTray [1978], is noted in Table 1. Using the data were drawn from the 1967 round of the National Longitudinal Survey, it found a significant negative coefficient relating average educational level of children at home to number of living children in the family.

Some historical evidence for the presently developed countries indicates that this negative trade-off was true once significant development and structural change had occurred. Francine van de Walle [1980] studied

Switzerland in 1870, 1888 and 1910, and found a strong negative correlation by cantons between marital fertility and the literacy and schooling level of military recruits from those cantons. Peter Lindert [1978, 1980] believes that the fertility decline in the United States (since 1800) was brought about partly by increased relative costs of children, including educational costs. Avery Guest and Stewart Tolnay [1981] found that fertility differentials across states in the United States in 1870 and 1900 were strongly negatively related to proportion of eligible children attending secondary school. The results were less clear, however, for micro-data. Hashimoto [1980], in a study of the fertility decline in Japan between 1900 and 1962, found that child quality, as measured by the proportion of primary school graduates going on to secondary school, was negatively related to the birth rate. The regression coefficients were significant, however, only for a cross-sectional analysis of prefectures in 1920 and 1935, and not for the time series equations. While the historical record on the relation of schooling to fertility is ambiguous [e.g., Easterlin, 1976; Graff, 1979; and Knodel and van de Walle, 1979], there is evidence of an increasingly strong quantity/quality trade-off as development proceeds. Eva Mueller [1983] concludes that the Becker type quantity/quality trade-off applies more to industrial societies than to low income, rural, agrarian developing groups or regions. When education is extensive and prolonged, and when incomes are high, the negative trade-off can be found [e.g., DeTray, 1978]. But in less developed rural areas, the relation may be only weakly negative, zero, or even positive. The same conclusion was also reached in a study by Birdsall and Cochrane [1982]. The evidence cited above tends to confirm it.

One additional consideration should be made in closing. The whole issue of children's education and parental fertility and child care behavior involves an interchange between generations. Economic theory has been moving in recent years to a study of multiple generation models. Two examples are Birdsall and Cochrane [1982] and Willis [1982]. This paper, however, will remain largely on a descriptive level and will examine some historical and contemporary evidence on schooling, fertility and mortality to see what the patterns have been.

3. The Historical Experience of Developed Countries

3.1 Fertility and Mortality Trends

The development process has, as one of its major characteristics, the transition from high to low levels of fertility and mortality [Kuznets, 1966, pp. 40-56]. As a consequence, by definition all presently developed nations have achieved a demographic transition. From that developed group (Western and Northern Europe, Spain, Italy, the Soviet Union, Eastern Europe, the U.S., Canada, Australia, New Zealand, Israel and Japan), five countries were selected for description here: the United States, England and Wales, Germany, Sweden and Japan. The selection was based on a desire to obtain good data for reasonably long time periods for relatively large countries. Japan is of interest as the most developed "non-Western" nation, while the United States is distinguished for its early fertility transition. Britain experienced the first industrial revolution [Landes, 1969, ch.2], Germany had a rapid fertility decline [Knodel, 1974] and Sweden had a long history of excellent demographic data. Other cases clearly could have been chosen, but those seemed to give a good range of experiences and contexts.

The basic data are presented in Appendix Tables A.1 to A.5. A number of measures of fertility and mortality are included. For fertility, these include Coale's indices of overall fertility (I_f), marital fertility (I_g), proportions married (I_m), and illegitimate fertility (I_h); the crude birth rate (live births per 1000 population per annum); the total fertility rate (TFR) (the sum of age-specific birth rates for women aged 15 to 44); and the net reproduction rate (NRR) (the sum of age-specific female birth rates for women aged 15-49, adjusted for the mortality of women between birth and the child-bearing ages). A definition of the Coale indices is given in Table A.6. Basically, I_f measures the number of births generated by a female population relative to the number of births they would have generated were they to experience the age-specific marital fertility rates of U.S. Hutterite women in the 1920s (the highest fertility group ever observed). I_g gives the same ratio for married women in a given population. So, for example, total women in England and Wales in 1851 produced 35% (I_g = .349) as many births as they would have if they had experienced Hutterite fertility rates. Similarly, married women in England and Wales in 1851 produced almost 68% (I_g = .675) as many births as they would have with Hutterite fertility. I_m is a ratio of age-weighted married women to age-weighted total women, the weights being the Hutterite age-specific fertility rates. Finally, I_h is the ratio of illegitimate births to the births that non-married women would have produced with Hutterite fertility. The total fertility rate (TFR) basically gives the number of births a woman would have if she experienced the current period fertility rates over her reproductive lifetime. The net reproduction rate gives the number of girls surviving to adulthood that a woman produces. A replacement level of NRR is 1.0. The mortality measures

include q(15), the proportion of children dying between birth and age 15 (from period life tables); the infant mortality rate (IMR), or deaths before age one per 1000 live births; and the crude death rate (CDR), or deaths per 1000 population per annum.

The data are of reasonable quality, particularly those from Germany and Sweden [Knodel, 1974; Hofsten and Lundstrom, 1976]. The early English birth data suffer from some underregistration, but it is not overly serious [Teitelbaum, 1974]. The U.S. data consist of a large number of estimates, because of the absence of vital registration in most states prior to the early 20th century. The Japanese data are quite reliable after 1920, but are of lesser quality prior to that date [Taeuber, 1958].

In general, England (Table A.1) experienced its demographic transition from the 1870s onward, with a sustained decline in fertility beginning then from a TFR of about 4.7 Mortality appears to have declined from the 1860s, but only had a sustained decline from the 1890s. The fertility decline was largely caused by reductions in fertility within marriage (I_g) and not by changes in nuptiality (I_m). Germany (Table A.2) followed a similar pattern, with a sustained decline in fertility dating from roughly the 1870s and mortality beginnnng its decline at about the same time. The data for Germany do not furnish a TFR, but the I_f of .428 in 1875 would correspond to a TFR of about 5 to 6. Again, marital fertility was the source of the change, since nuptiality (I_m) remained virtually unchanged between 1875 and 1925. The third European country considered, Sweden (Table A.3), also did not undergo a fertility transition until the latter half of the nineteenth century. Fertility did not begin to decline until the 1860s, as measured by I_f, and the TFR did not commence its sustained decline until

after 1880. Mortality seems to have begun its irreversible reduction during the period 1860-1880. With the notable exception of France [van de Walle, 1974], the countries of western and northern Europe underwent their fertility declines period between 1880 and 1914 [Lesthaeghe, 1977, p. 4]. Mortality frequently declined concurrently, or with a lag of a decade or two.

The United States (Table A.4) was somewhat different. Fertility (as measured by the TFR or CBR) declined in the United States throughout the nineteenth century from very high levels, e.g., a TFR of 7-8 in 1800 for the white population. This decline is, in fact, historically quite unusual, since the United States was not urban or industrial to any significant extent until the latter half of the century. (France is another exceptional case of sustained pre-industrial fertility decline.) The U.S. experience has prompted a fairly considerable literature on the role of land availability and child costs as factors in the fertility decline [Yasuba, 1962; Forster and Tucker, 1972; Easterlin, 1971, 1976]. Mortality, by contrast, did not seem to exhibit a sustained downward trend until after about 1880.

Japan (Table A.5) was, in contrast to the United States, a later participant in the demographic transition. As indicated by the CBR, the fertility decline began only after about 1920. There is, however, reason to suspect the accuracy of the numbers prior to 1920 [Mosk, 1977, pp. 657-658; Taeuber, 1958, pp. 40-44]. Nonetheless, after 1920, fertility decreased consistently, from a TFR of nearly 5.5 to 2.0 in 1959/61. Mortality also declined after 1920, concurrently with fertility. Japan thus appears to have had simultaneous mortality and fertility declines, unlike the United States, where fertility declined before mortality.

These historical demographic levels and trends from developed countries can be contrasted with the contemporary experience of developing nations. Several points stand out. First, levels of fertility prior to the onset of the fertility transition were, with the exception of the land-abundant United States, relatively moderate (with TFRs in the range of 4-6). Many LDCs have (or had) TFRs above 6 (see section 4 below). Second, the pace of decline was slower historically for the developed countries. Third, unlike the experience of most developing nations since World War II, mortality decline did not necessarily precede the fertility transition. Mortality reduction was either simultaneous with or later than the fertility declines in all five cases presented here. Fourth, mortality levels historically were high, even during the transition. Life expectancy corresponding to the q(15)s in Tables 3-7 ranged from about 37 to 48 years for the pre-transition period, in contrast to 50-70 years in most LDCs today. Finally, as a result of lower fertility and higher mortality, the proportion of children (below age 15) was historically lower in developing countries (30-40 percent) than in today's LDCs (with 40-50 percent below age 15). Thus, historically, the demographic transitions of the developed countries were rather different from those of today's LDCs [see Kuznets, 1954; Teitelbaum, 1975].

3.2 Enrollment Rates

Tables A.1 to A.5 also present data on school enrollment, using gross enrollment rates (GERs). For each of the five countries, information was collected on primary and secondary school enrollment (however defined by the country). Census data on the school age population was also sought, but these

were only approximate since the census data appeared in the standard reference sources in quinquennia 5-9, 10-14, and 15-19. Most primary schooling takes place between the ages 6-13 and most secondary schooling between the ages 14-18. As a compromise in the computation of GERs, primary enrollment was related to children 5-14, secondary enrollment to children 10-19, and primary plus secondary enrollment to children 5-19. While this may create some variations due to differences in compulsory school ages, age structures, and age misreporting, it was felt that use of the same age categories for the denominators for all countries would facilitate comparisons. Probably greater error is introduced by variations in attendance rates or in differing lengths of school year. Another problem associated with school enrollment figures is that they do not always cover the whole period of the demographic transition (e.g., for the United States). This was especially true for data on secondary schools.

Bearing these qualifications in mind, it appears that, as of the mid-nineteenth century, there were considerable differences among these five countries in degree of educational participation. In 1850 in the United States, 47 percent of the total population aged 5-19 and 56 percent of the white population in the same age group were enrolled in primary and secondary school. This contrasts with a mere 8 percent of children aged 5-14 enrolled in primary school in England and Wales in 1851. By 1870, the primary GER had risen in England to 26 percent, but by that date it was 74 percent in the United States, 64 percent in Germany and 57 percent in Sweden. Even late-comer Japan had achieved a primary GER of 35 percent by 1888. In England, Germany, Sweden and Japan the primary GER peaks out at about 70-80 percent. In Germany, the peak was reached in 1939, in England in 1931, in Sweden in 1910, and in Japan in 1940. Not too much can be made of these differences, since they likely reflect differences in compulsory schooling

ages. This is indicated by the U.S. data, with primary GER's peaking at 97 percent in 1940 but whose population was no more literate than the other developed nations at that time.

Secondary GERs are, as one would expect, much lower. Initial observations for these range from 0.86 percent for the United States in 1870 to 1.44 percent for England in 1904. The secondary GERs increase in relative terms much faster, reflecting the growing importance of extended human capital investment during modernization and industrialization. By 1970, the secondary GER was 54 percent for England and Wales; 61 percent for Sweden; 52 percent for the Federal Republic of Germany; 50 percent for the U.S.; and 53 percent for Japan. Secondary gross enrollment rates have thus continued to grow, while primary rates have leveled off, reflecting the very high levels of primary enrollment which had been achieved in all five of those developed countries by the time of the First World War. Increases in secondary enrollment have continued past the mid-point of the twentieth century.

3.3 Graphical Relationships Between Fertility and School Enrollment, 1850-1960

Some patterns appear in the data, graphed in Figure 1. First, there was not a particularly good correlation between the level of the primary school enrollment rate and the date of fertility decline. This may perhaps be better seen in Table 3. The level of the primary GER at the onset of fertility decline ranged from 38 percent (England and Wales) to 65-66 percent (Germany and Japan). Sweden's was probably below 57 percent, although sustained decline in TFR (as opposed to I_f and CBR) began only in 1880, when the primary GER was about 59 percent. For the decade during which the CBR fell below 30, never to rise above it again, there was a range of primary GERs of 65-92 percent. Finally, for the date at which marital fertility (I_g)

fell irreversibly by 10%, there was a range of primary GERs of 60-74 percent. The conclusion seems to be that a substantial level of primary GER had to be attained (e.g. above 50-60 percent of population aged 5-14) before significant fertility declines would occur. The U.S., with its early fertility decline, was probably an exception. England and Wales was likely not an exception, since its late fertility decline did not accelerate until primary GER was above about 60 percent.

A second conclusion is that secondary GERs also showed considerable variation with respect to the dates of fertility decline, but that they did not have to rise above 5-6 percent of population aged 10-19 before significant declines would occur. The primary GER did not rise too much after fertility decline had become significant (e.g., a 10 percent decline in marital fertility), but the secondary GER continued to rise through the very low fertility rates of the present. It seems that the quantity-quality trade-off was related to the <u>trend</u> in the secondary GER, but not much to the trend in primary GER. A substantial initial <u>level</u> of primary GER seems to have been a prerequisite for substantial irreversible fertility declines, however.

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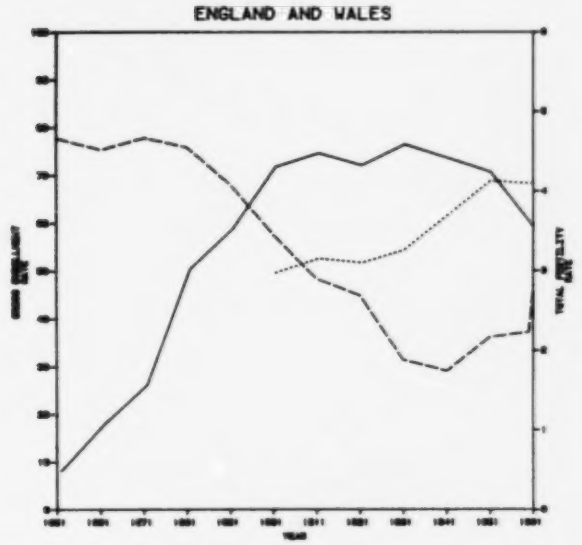
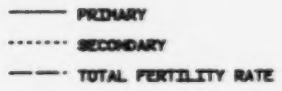
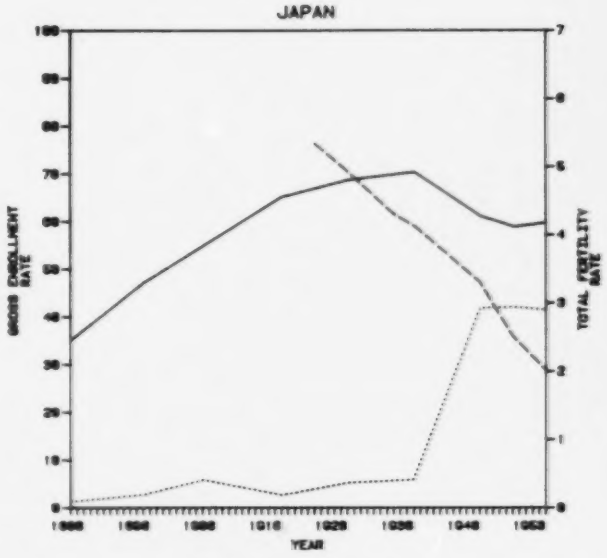
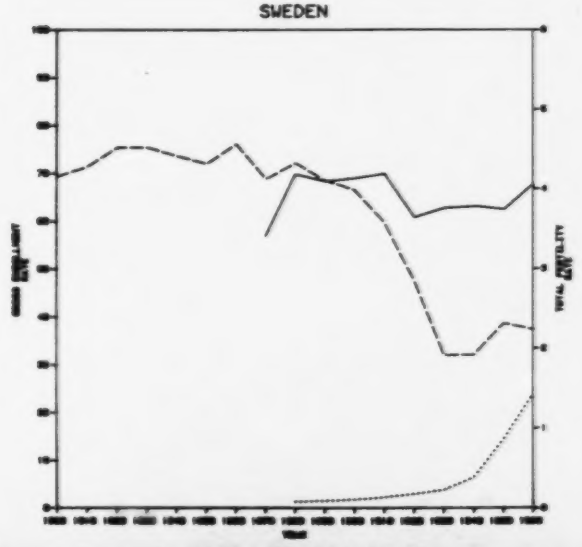


Figure 1: Fertility and Enrollment Trends in Five Developed Countries, 1800-1960







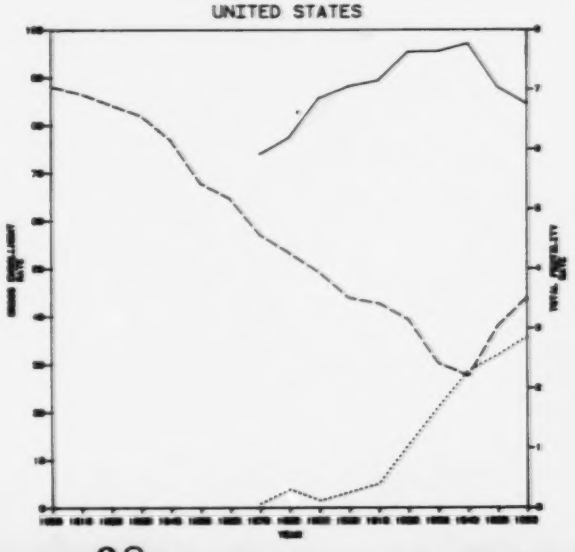


Table 3: Relationship between Gross School Enrollment Rates and Fertility Decline, Five Developed Countries

Country	Event/Date	Gross Enrollment Rate (%) Primary	Secondary
1. England & Wales	(a) Date of onset of fertility decline: ca. 1875.	38	below 1.4
	(b) Decade in which CBR falls below 30 (never to rise above it again): 1890's.	65	below 1.4
	(c) Date at which marital fertility declines 10%: 1892	60	below 1.4
2. Germany	(a) Date of onset of fertility decline: ca. 1875	66	2.3
	(b) Decade in which CBR falls below 30 (never to rise above it again.): 1880's	72	4.7
	(c) Date at which marital fertility declines 10%: 1890	74	3.6
3. Sweden	(a) Date of onset of fertility decline. ca 1860	below 57	below 1.3
	(b) Decade in which CBR falls below 30 (never to rise above it again): 1880's	69	1.4
	(c) Date at which marital fertility declines 10%: 1900	69	1.8
4. U.S.A.	(a) Date of onset of fertility decline: ca 1800	below 74	below 1.3
	(b) Decade in which CBR falls below 30 (never to rise above it again): 1910's	92	9.1
	(c) Date at which marital fertility declines 10%: n.a.	-	-
5. Japan	(a) Date of onset of fertility decline: 1920?	65	2.6
	(b) Decade in which CBR falls below 30 (never to rise above it again): 1930's	70	5.6
	(c) Date at which marital fertility declines 10%: 1932	69	5.4

Sources: Tables A.1 - A.5.

3.4 The Costs of Education

Costs of education, as mentioned above, would include direct and indirect costs. Direct costs would comprise school fees, books, supplies, school uniforms, etc. Caldwell [1982, ch. 10] also contends that children who attend school receive more and better quality resources than if they were not attending school. The indirect costs would be the opportunity cost of the child's time in terms of foregone labor. Opportunity cost of the mother's time, while definitely important in the cost of the child, would seem to have less bearing directly on education cost. One exception might be the de facto child care services furnished by schools. Another possible influence is the positive correlation between mother's education, and hence the opportunity cost of her time, and her educational aspirations for the child. Some of the difficulties in defining the cost of children have been discussed in Birdsall, Cochrane and van der Gaag [1983] and in Espenshade [1972].

It is not especially easy to obtain information on historical education costs. One area for which data are available is the United States. [Fishlow, 1966; Solmon & Tierney, 1980; Solmon, 1975.] Some information on this appears in Tables 4 and 5. There it is evident that educational expenditures grew over the period 1840 to 1900, with expenditures per pupil and expenditures as a share of GNP rising. The share of government spending rose from 47 percent of total direct costs (expenditures) in 1850 to 79 percent in 1900. Thus total direct cost per pupil rose from $6.25 to $16.78 in current dollars (or about $7.11 to $16.78 in dollars of 1900). Of this, private expenditure per pupil rose from only $3.31 in 1850 to $3.52 in 1900 in current dollars, and it actually fell from $3.77 to $3.52 in dollars of 1900. The government was clearly picking up a much larger share of the total direct burden of education over time. This burden only amounted to 1.7 percent of GNP by 1900 and of that the government was assuming 80%.

Table 4: Expenditures on Education in the United States, 1840-1900 (current dollars)

Year	Direct Expend. ($ million)	Direct Public Outflows ($ million)	% Direct Expend. Public	Opport. Cost ($ million)	Total Resource Cost ($ million)	Direct Expend. Relative to GNP	Resource Costs Relative to GNP	Public Outlays Relative to Total Govt. Spending	Public Outlays Relative to State & Local Expenditures	Direct Expend. Per Pupil ($)
1840	9.2	n.a.	n.a.			.006				
1850	16.2	7.6	47			.007				6.25
1860	34.7	19.9	57	24.8	59.5	.008	.014	.13	.21	6.39
1870	95.4	61.7	65			.013		.10	.22	13.19
1880	106.4	81.5	77	72.1	178.5	0.11	.018	.14	.26	9.89
1890	187.3	147.4	79			.015		.17	.26	14.52
1900	289.6	229.9	79	213.9	503.5	.017	.029	.16[a]	.25[a]	16.78

[a] 1902.

Source: Fishlow (1966).

Table 5: Relative Educational Expenditures: U.S., U.K., and Germany 1860-1900 (Current $)

Country	Year	Expenditure ($ million)	% of GNP	Income per capita ($)	Expendisture per pupil ($)
United States	1860	35	.8	126	6.39
	1880	106	1.1	197	9.89
	1900	290	1.7	227	16.78
United Kingdom	1860	-	-	-	-
	1880	59	.9	186	15.49
	1900	124	1.3	241	16.40
Germany	1860	24	1.0 /a	60	5.95 /b
	1880	70	1.6 /a	94	9.91
	1900	160	1.9 /a	144	14.57

/a % of NNP; /b 1867

Source: Fishlow (1966). Estimates of income per capita prior to 1900(a) U.S.: Berry (1978), Table 1B. United Kingdom: Mitchell (1975). Germany, Hoffmann (1965). Pupils: Banks (1971) adjusted in 1880 for the U.K. for secondary enrollment.

Indirect costs (i.e. opportunity cost of children's work foregone) were considerably larger, and amounted to 42 percent of total resource costs in 1860, 40 percent in 1880, and 42 percent in 1900. A somewhat higher fraction for indirect costs was found by Solmon for 1880 and 1890, being 58 and 57 percent respectively. [Solmon, 1975; and Solmon & Tierney, 1980]. The ratio of indirect to direct costs were .715, .678, and .739 for the three years, respectively. If one adds together opportunity cost and total private direct cost, one finds that the proportion of total private cost (direct and indirect) which was due to opportunity cost rose from .626 in 1860 to .743 in 1880 to .782 in 1900. In the United States in the late nineteenth century, it was clearly becoming increasingly expensive to educate children, not because direct private out-of-pocket costs were great (they were not), but because the opportunity cost of a child not working was becoming greater. Opportunity cost per child was rising (from $4.52 in 1860 to $6.72 in 1880 to $11.43 in 1900 in current dollars) for a number of reasons: longer school attendance per year, longer number of years in school per student, rising child wages, and an increased number of pupils in urban, industrial employment where the opportunity cost of education was much higher. The much lower opportunity cost of education, particularly primary education, in rural areas was apparent in the United States in the late nineteenth century and probably played a role in the differentially higher fertility of rural areas, and particularly in the South, in the late 19th century [Tolnay, Graham, and Guest, 1982].

In the other countries for which data are readily available, Table 10 indicates that Germany systematically spent a higher proportion of its national product on education while England (in this case taken as the United Kingdom) spent somewhat less than the United States. In terms of expenditure

per pupil in relationship to GNP, Germany seems to have had a ratio of per pupil spending to national product per capita in the range .09 to .10, while the U.K. had a ratio in the range of .7 to .8 and the U.S. had a range of .5 to .75. In Germany, much of the spending on education seemed to have been governmental, Germany having had widespread compulsory, free public education by the early part of the nineteenth century [Levasseur, 1897]. In Prussia, the largest state in Germany, literacy was quite high, for example. In 1850, only about 10 percent of bridegrooms were unable to sign the marriage register, only 5 percent of military recruits could not read, and an estimated 20 percent of the whole adult population (male and female) was illiterate. As of 1871, only 12 percent of the adult population was enumerated as illiterate [Cipolla, 1969]. Germany was thus, prior to the demographic transition, a relatively well educated society.

With respect to education, Germany was similar to the United States which, in 1850, recorded adult illiteracy of only about 10-15 percent among the total white population aged 10 and over. This fell to 6 percent by 1900 and 3 percent by 1930. This came about in the United States without the benefit of compulsory free public schooling. The first state to enact a compulsory education law was Massachusetts, in 1852. Only one other state (Vermont) had enacted a similar law by 1870, but thereafter progress in achieving some compulsory education laws in the northern and western states was rapid. By 1918, all states had some such laws. Many of the laws did not enforce attendance for more than 3-5 months and common attendance ages were set at 8-14 years [Landes and Solmon, 1972, Table 1]. This illustrates the diversity of the legislative environment within the United States and also the relative lateness of legislative compulsion to primary education. (Secondary

education was rarely made compulsory until well into the 20th century.) It has indeed been argued that compulsory schooling laws only came into effect when there was already a substantially high primary enrollment rate on a voluntary basis [Landes and Solmon, 1972].

England and Wales were a case of less governmental intervention. A substantial role of the state in education did not come about until 1870 and legal requirements on parents for the education of their children not until 1876 [West, 1970a]. A spate of further restrictions on parents and children followed [Caldwell, 1982, p. 311]. Although this coincided closely with the rise of compulsory education, there is evidence that private education had achieved considerable success in the earlier part of the century. By 1851, about 65-70 percent of the adult population was literate and significant progress in private schooling was apparent [West, 1970b. Cipolla, 1969]. This belies the low enrollment rates given in Table A.1. By 1880, a considerable amount per student was being spent in the United Kingdom. One might compare this to an estimate by West [1970b, pp. 86-87] of about 1 percent of net national product being spent privately on education in 1833 amounting to about $6.18 per pupil. After 1870 the share of spending shifted rapidly to the government, at least for primary education.

Sweden was rather more similar to Germany with regard to education. It had a compulsory school system by 1842 [Jorberg, 1973, p. 386] and, in 1850, only about 10 percent of the population aged 10 and over was illiterate [Cipolla, 1969]. Sandberg [1979] has noted the extraordinarily high level of human capital formation relative to its level and stage of economic development. "By the late 1860's, at the latest, Sweden had a system of universal elementary education, and the supporting structure of teacher

training institutions, in full operation." [Sandberg, 1979, p. 230.] Between 1870 and 1914, primary enrollments increased little, but educational expenditures (largely government expenditures) per pupil increased. Sweden also seemed to have had a "taste" for high secondary and university enrollments. During the period 1870 to 1900, enrollment ratios in secondary schools increased only modestly, but they were still among the highest in Europe, indicating a strong commitment to secondary education already in the middle of the nineteenth century. It is significant, however, that Swedish secondary enrollment rates and expenditures (again largely governmental) on secondary education began a strong increase after 1900 [Sandberg, 1979, p. 231], a period coincident with its fertility decline.

Finally, there is the interesting case of Japan. Prior to the Meiji restoration of 1868, it has been argued that there was a considerable level of literacy and school enrollment [Dore, 1965; Rosovsky, 1966, pp. 104-106]. By 1868, about 40-50 percent of boys and 15 percent of girls were believed to receive some schooling [Dore, 1965]. Most of the pre-Meiji education was privately funded. When the state did begin to fund education, local governments had to pick up most of the burden [Rosovsky, 1966]. Private fees continued to be a significant burden and a deterrent to attendance, particularly in rural areas. They were abolished in 1898 and then progress toward universal primary education resumed [Landes, 1965, p. 108]. Although, prior to 1868, education was fairly widespread among samurai, merchants, and richer farmers, and was reasonably secular, reforms were introduced. The alphabet was simplified. A Ministry of Education was established in 1871 and the basic education system law was promulgated in 1872. The system was standardized nationally and four years of elementary schooling were made

compulsory in 1886, extended to six years in 1907. Primary and secondary school enrollment as a percentage of population 5-19 was perhaps 10 percent in 1868 [Rosovsky, 1966, p. 106] and rose to 26 percent by 1888 and 42 percent by 1908. The Japanese state began to spend heavily on education after 1900. (As an example, in real terms [in 1910 million yen], expenditures were 1880, 10.7; 1896, 19.3; 1900, 50.2; 1910, 90.9.) [Oshima, 1965; price index from Kelley and Williamson, 1974, Appendix 1.] The expansion of education was, however, selective and moderately paced. [Maddison, 1969, pp. 16-17.] In 1880, 31 percent of children 5-19 were in primary and two secondary levels. This rose to 63 percent by 1915, 86 percent by 1950, and 94 percent by 1963. In upper secondary education, only 1 percent of the population aged 15-19 were enrolled in 1880, but this rose to 21 percent in 1915, 71 percent in 1950, and 92 percent in 1963. [Maddison, 1969, Table 6.] Increasingly costs were borne by the government, but private spending, particularly at the secondary and university levels, still continued to be important. [See, for example, Yamamura and Hanley, 1975.]

In general, from these fragmentary data one can draw some tentative conclusions. First, for these five presently developed countries, educational costs generally rose (in real terms) from the mid to late nineteenth century onward. Second, government spending appeared to have taken over an increasing share of direct costs, although this varied by country. Third, as a consequence, direct private costs rose only slowly, if at all. Fourth, private indirect costs rose over time for a number of reasons. Among these were rising wages and a shift of the population from agriculture to urban-industrial locations where opportunity costs of education at higher levels tended to be higher. Fifth, primary school education did not seem to

constitute much of an economic burden, especially after the government began providing all or part of the fees (e.g. in England after 1870 and Japan after 1898). And, sixth, the direct and indirect costs of secondary (and higher) education were increasingly of consequence and so the growth of enrollments in secondary education was associated with greater parental burdens. The evidence on this last point is, however, not abundant.

3.5 Private Returns to Schooling

The other side of the calculation from costs is benefits or returns. Unfortunately, there is a distinct paucity of information on this directly. One can infer, in the face of rising indirect private costs, that private returns to education must have kept pace with the rise in costs in order to keep an acceptable rate of return. Some time series data for the United States are available [Becker, 1975, ch. VI] and indicate that since the 1930's the private returns to a high school education have been well above 10 percent and generally well above that of a college education. Some scanty evidence points to a decline during the period 1900 to 1940 and then a rise in the rates of return between 1940 and 1960. Other work on the U.S. [Carnoy and Marenbach, 1975; Hansen, 1963; Mincer, 1962] and Britain [Ziderman, 1973; Morris and Ziderman, 1971] tend to confirm a rate of return above 10 percent to completed secondary and completed college education. [See Blaug, 1972, pp. 224-234.]

Historical information tends to be even more scanty, since a relatively small proportion of adults had completed secondary school or university prior to 1900, even in the industrial countries. Schools above the primary level were few and small, and often specialized in subjects such as

preparation for the ministry, rather than in technical training. In the 19th century (and earlier), many technicians and professionals (e.g. physicians, lawyers) were educated on the job and/or through apprenticeships.

An important benefit of children is clearly the contribution they make to their families. While schooling keeps children out of the labor force at an early age, it enhances their earning potential when they eventually enter the labor force. Some historical research with micro-data for working class families in the United States and Europe from the 1889/90 U.S. Commissioner of Labor Survey [Haines, 1979a, ch. 6, 1979b, 1981, 1983] reveals that late nineteenth century families relied heavily on the earnings of children to make up for declining earnings of the family head. For example, only about four percent of total income for families with household heads aged 30-39 was from children. For families with heads aged 50-59 (with older children, on average), this proportion had risen to 33 percent. Children often remained in the home, worked, and contributed to the family before they left for marriage and their own household formation. This was noted for Lancashire in England in 1851 [Anderson, 1971], for Hamilton in Canada in 1861 and 1871 [Katz and Davey, 1978], for late nineteenth century Philadelphia [Haines, 1981; Goldin, 1979, 1981; Modell, Furstenburg, and Hershberg, 1981] for the nineteenth century, United States generally by Kett [1973]; for England in Pinchbeck and Hewitt [1973, ch. XIV]. The importance of children to the family economy in Japan in the nineteenth and early twentieth centuries has been the subject of comment [e.g. Taeuber, 1958, ch. V; Lockwood, 1954, pp. 556-559]. Some evidence points to the fact that historically children did indeed make substantial transfers to their parents and families. This was noted in the report of the U.S. Commissioner of Labor on "Working Women in

Large Cities" [U.S. Commissioner of Labor, 1889], which found that about half of single working women living at home in U.S. cities gave up their entire earnings to their parents. There is also support for the view that parents kept their children in school longer if their incomes were higher, thus investing their higher "savings" in human capital [Haines, 1979, 1983]. This confirms the observed historical trade-off between child labor and schooling [Ensign, 1921] and suggests, at least by the late nineteenth century in urban, industrial areas, that parents preferred extended children's education to early child contributions to the family economy. This supports the view that the net benefits of children to families were declining as parents opted in increasing numbers to keep children in secondary school. Such benefits as did occur were greatly delayed and usually reduced. For example, Modell, Furstenberg, and Hershberg [1981, p. 335] report for Philadelphia in 1880 that a young man or woman would spend an average of seven years in the labor force while in their family of birth and that they would contribute to family income.

In contrast, by 1970, children would remain only 2.5 years in their home while working and would contribute relatively little to the family income. Anderson [1971] and Katz and Davey [1979] indicate that this prolonged earning period in the natal family was more a development of urban, industrial society historically, since earlier in rural areas children had often been sent off as servants. Nevertheless, the shift from a substantial benefit to family income from children's earnings (or at least the benefit of reduced consumption requirements from an early child departure) to prolonged secondary and university schooling has marked developed countries since the late 19th or early 20th centuries. The ratio of benefits to costs has fallen, and the net flow of resources appears to have shifted in favor of children as

the quantity-quality tradeoff operated. One further consequence of this loss of children's income has been to create pressure for married women to enter the labor force. This has been happening in developed countries since about 1900 and has placed additional downward pressure on fertility by raising the shadow price of quantity (via the opportunity cost of women's time). [Tilly and Scott, 1979; Oppenheimer, 1982.]

As a final note, it should be pointed out that the demographic transition in those developed countries has also been accompanied by large reductions in childhood mortality [e.g. q (15)] (see Tables A.1 to A.5). These reductions reduced risks associated with investing in child quality and hence reduced the cost (and price) of child quality. Although this raised potential benefits associated with child quality, it ultimately was probably of secondary importance to changes in demand for skilled labor which induced increased demand for child quality by reducing its shadow price.

3.6 Other Considerations: Child Labor Laws

In general, there has been a negative correlation observed between schooling and child labor laws [e.g. Haines, 1979. Ensign, 1971]. The question is, however, whether the child labor laws were a major cause of increased schooling by reducing the opportunity cost of children's time (i.e. indirect schooling costs) and hence reducing the shadow cost (and price) of child quality. Given the timing of these laws relative to changes in schooling, however, it appears that compulsory education and child labor laws rather ratified changes in demand for quality. The laws may have served to accelerate the process to universal primary schooling but, in general, they did not seem to cause it. This could be seen in the United States in the late

nineteenth century where variations in child labor were indeed negatively correlated with child labor restrictions [Haines, 1979], but Landes and Solmon [1972] found no significant effect of child labor laws on school enrollments in a multiple regression analysis of U.S. states in the late 19th century. Caldwell [1962, p. 311] notes a number of child labor laws in 19th century Britain [1833, 1844, 1847] which restricted hours of work that seemed to have little effect on fertility until they were supplemented by a movement to mass education. In Germany, child labor in mines was not severely restricted until 1903. It appears the employment of children in factories and mines (as opposed to agriculture and domestic service) was on the decline in Europe in the late 19th century because children became less useful [Stearns, 1967, p. 130]. An analysis of the British experience in the 19th century by Nardinelli [1980] concluded that rising real incomes and technological change were the main causes of decline in child labor. Child labor laws only accelerated a process already taking place. This would have created an environment favorable to child labor legislation. In Japan, despite some efforts to protect children, still 23 percent of children aged 10-14 were gainfully employed in 1920 [Taeuber, 1958, Table 27]. In sum, child labor laws did not seem historically to have had a dramatic initial causal role in promoting schooling by reducing the cost of child quality, although they may well have had an effect on it once primary schooling had become widespread.

4. The Experience of Developing Countries

4.1 Fertility and Mortality Trends

For present purposes, we focus on the demographic experience of 18 LDCs, including six from Latin America, eight from Asia, and four from Africa. These countries encompass a broad range of fertility and mortality levels and trends over the last twenty to thirty years; some of them may be characterized as having undergone the demographic transition to varying degrees, while, in the others, this transition has occured only very slightly, if at all.

Before proceeding, it is useful to bear in mind the considerable differences in data quality of the countries chosen, a shortcoming that largely reflects differences in methods of estimation and also coverage of data collection. Among the countries presented below, the fertility data are judged to be reliable only for Egypt and Tunisia in Africa; Costa Rica, Mexico and Chile in Latin America; and Hong Kong, Singapore, Sri Lanka, and Taiwan in Asia [UN, 1979a]. The reliability of the mortality data are similarly weak, but since these data are presented here only for the purpose of completing the demographic picture, this shortcoming poses no serious problems. Despite the data flaws, however, it can be argued that, in looking at broad changes of relationships over time, even the rough data available to us now can provide some insights.

The simplest measures of fertility/mortality are the crude birth and death rates.3/ In conjunction, they provide an indication of the rapidity of population growth, but when used to compare fertility or mortality between countries and over time they present a problem because of

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3/ Defined as number of births or deaths per 1000 population.

their dependence on the population age structure. Thus variations could indicate a change in fertility/mortality, or a change in the age sructure, or both. A better indicator for fertility is the total fertility rate (TFR)[4]; for mortality it is the expectation of life at birth (e^0). Since this paper is not primarily concerned with population growth as such, we can use the TFR measure for fertility; and e^0 for mortality.

Tables B.1 to B.18 in Appendix B contain the fertility, mortality and enrollment data for countries included in this study. On average, African fertility exceeds that in any other continent; within Africa, fertility in the Eastern and Western regions are the highest. The estimated 1980 TFR for Ghana (7.0) and Kenya (8.0) are illustrative; moreover, fertility in these countries has remained stable at these high levels for most of the last two to three decades. In Egypt and Tunisia, fertility is somewhat lower with estimated 1980 TFR's of 4.9 and 5.3 respectively. Between 1950 and 1980 both countries experienced declines in the TFR of about 20 to 25 percent. Some authors have tentatively attributed the decline in Tunisia to government policies in the late 1960's, including family planning and improvement in the status of women. In terms of mortality, life expectancy has improved considerably since the 1950's for most of Africa, but it remains low in comparison to other parts of the developing world; 45 years compared to 49 years in South Asia; and 62 years in East Asia and Latin America. The 1980 life expectancy in the four countries included here exceeds the average for Africa; in Egypt, Ghana and Kenya, it is around 55 years while in Tunisia, it is about 60 years.

4/ Defined as the total number of children that would be born per woman among a group passing through life subject to given age specific fertility rates.

In Asia, the fertility experience encompasses a wider range of levels and trends. For Hong Kong, Singapore, the Republic of Korea and in Taiwan, China, the estimated 1980 TFR does not exceed 3.0; thus in these countries, fertility is comparable to the level characteristic of Western industrialized countries. On the other hand, India and the Philippines continue to experience high fertility although the level is not nearly as high as in parts of Africa. For Sri Lanka and Thailand, fertility is at moderate levels. In terms of trend, the most dramatic declines took place in the first four East Asian countries listed above; from 1950 to 1980, the TFR fell by between 49 and 72 percent, the largest decline having occurred in Singapore. The remaining Asian countries have also experienced declines in this period, although the rate of decline had been slower, averaging 20 to 40 percent. As with fertility, mortality conditions in the four Asian countries with the lowest fertility compare favorably with that in Western countries; in 1980, life expectancy ranges from 74.5 years in Hong Kong to 65.4 years in the Republic of Korea. In the remaining countries, it is over 60 years in Thailand, Philippines, and Sri Lanka, but only 51.8 years in India.

Among Latin America countries considered, only Barbados and Chile have a 1980 TFR not exceeding 3.0. Of the six countries included, Mexico probably has the highest fertility with a TFR of 5.1 in 1980. All six countries, however, share the common experience of a fertility decline in the three decades preceding 1980; the decline is over 40 percent in Colombia and Costa Rica; over 30 percent in Barbados, Chile and Brazil; but only 25 percent in Mexico. As with the Asian countries, life expectancy is generally high in Latin America. In Barbados and Costa Rica, it exceeds 70 years, while in none of the remaining four countries does it fall below 62 years.

4.2 Enrollment Trends

Gross Enrollment rates (GERs) for primary and secondary schools are used as indicators of the level of children's schooling in this study. They are defined as the ratio of school enrollment at a given educational level to the total population in the corresponding age range.5/ The reliability of these statistics for time series and cross country comparisons depends on the reliability of both the denominator and numerator in each case; the former is likely to be inaccurate because of age-misreporting, and the latter, because of incomplete coverage of the school population, a problem which arises, for example, when privately enrolled students are omitted through lack of information on them. Thus, differences between countries and trends within countries probably cannot be entirely attributed to genuine differences or change in enrollment. In some countries, even assuming data reliability, comparisons are difficult to make because of changes in the age range corresponding to school enrollment at a given level; for example, in Brazil, the erratic movements in the primary school GER between 1965 and 1975 is partly due to this problem.

A peculiarity of the GER is that theoretically it does not have a well-defined upper limit, since its numerator, is not confined to the same age range as its denominator.6/ Thus a GER that exceeds 100 percent not

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5/ For most countries, the age range for primary enrollment is 6 to 11; and 12 to 17 for secondary enrollment.

6/ The net enrollment ratio is a better statistic to use, since the age range is the same for both its numerator and denominator. However, it requires more information to construct, and is thus not readily available for all the years and countries included in this study. For this reason, we have chosen the gross enrollment rate as the indicator.

only means that enrollment is high but also that some of the pupils at that level of schooling are overage. For the purpose of this paper, the GER is used to indicate the extent to which parents invest in their children by schooling them. A GER greater than 80 percent may be interpreted as corresponding to a situation where the tradition of sending children to school is fairly well-established, although by no means pervasive. For a country to be described as having attained universal education at a given level would probably require a GER exceeding at least 110 pecent.

Among the four African countries, Kenya and Tunisia boast a primary school GER of around 100 percent in the late seventies compared to around 70-75 percent in Egypt and Ghana. Considering the level from which these countries started two to three decades ago, the gains in enrollment are especially remarkable; for example, the primary school GER was merely 32 percent for Ghana in 1950 and Kenya in 1955. Similar gains in secondary school enrollment have been made; for example by the late 1970's the GER in Egypt was three times the level in 1960; in Ghana it was 36 times the 1950 level. However, in Kenya and Tunisia, the secondary school enrollment appears to have grown at a slower rate, possibly reflecting the greater emphasis of public policies on the first level of education compared to the second level.

In Asia, primary school enrollment has been at a high level since the 1950's for most of the countries in our sample. For example, the primary school GER in 1955 exceeded 80 percent in the Philippines, Singapore, the Republic of Korea, Taiwan, China and possibly also Sri Lanka; however, enrollment has increased steadily, and by the late 1970's, many of the Asian countries in this study had attained or are close to attaining universal primary education; the only exceptions are

India and Thailand, where the GER is around 80 percent. At the secondary level, enrollment in no part of Asia, except perhaps in Taiwan, China and in the Republic of Korea, are at the level characteristic of the more developed countries. Nevertheless, in terms of growth, enrollment has shot up dramatically in all of them in the last three decades. Around 1980, the secondary school GER was below 60 percent only for Thailand (29 percent) and India (27 percent).

The six Latin American countries included in this study all boast high levels of primary school enrollment; not only do the statistics indicate that there is a well-established norm of schooling children, but they also suggest that by the late 1970's, almost all school-age children attend primary school. However, at the secondary level, enrollment is high only in Barbados, which in 1978 had a GER of 72 percent. For the remaining countries, the secondary GER in the late 1970's was below 50 percent, except in Chile where it was 55 percent.

4.3 Graphical Relationships Between Fertility and Enrollment, 1950-1980

Figures 2 to 4 graph the fertility and enrollment trends for the 18 countries included in this study. These graphs reveal several interesting patterns:

(i) with rare exceptions, the primary school GER is at least 75 percent before a sustained decline in fertility can be discerned;

(ii) the decline in fertility is most significant in countries in which the primary GER has already stabilized beyond the 100 percent level, for example in Chile, Costa Rica, Barbados, Singapore, the Republic of Korea, Taiwan, China and Hong Kong;

(iii) as the primary GER increases it is possible for fertility to increase at the same time as was the case between 1950 and 1960 in Costa Rica, Chile and Hong Kong;

(iv) in quite a few countries, increases in the primary GER has not been accompanied by reductions in the total fertility rate, particularly when enrollment was rising from low levels. This relationship is apparent for various time periods in Colombia, Mexico, India, Egypt, Tunisia, and most notably in Kenya and Ghana;

(v) a downward trend in the total fertility rate is sometimes unaccompanied by increases in primary school enrollment, as in Thailand and Egypt; and finally;

(vi) a negative relationship between schooling and fertility trends is more frequently observed when the schooling indicator is secondary rather than primary enrollment; note especially the experience of Singapore, the Republic of Korea, Chile, Taiwan and China.

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Figure 2: Fertility and Enrollment Trends in Latin America, 1950-1980

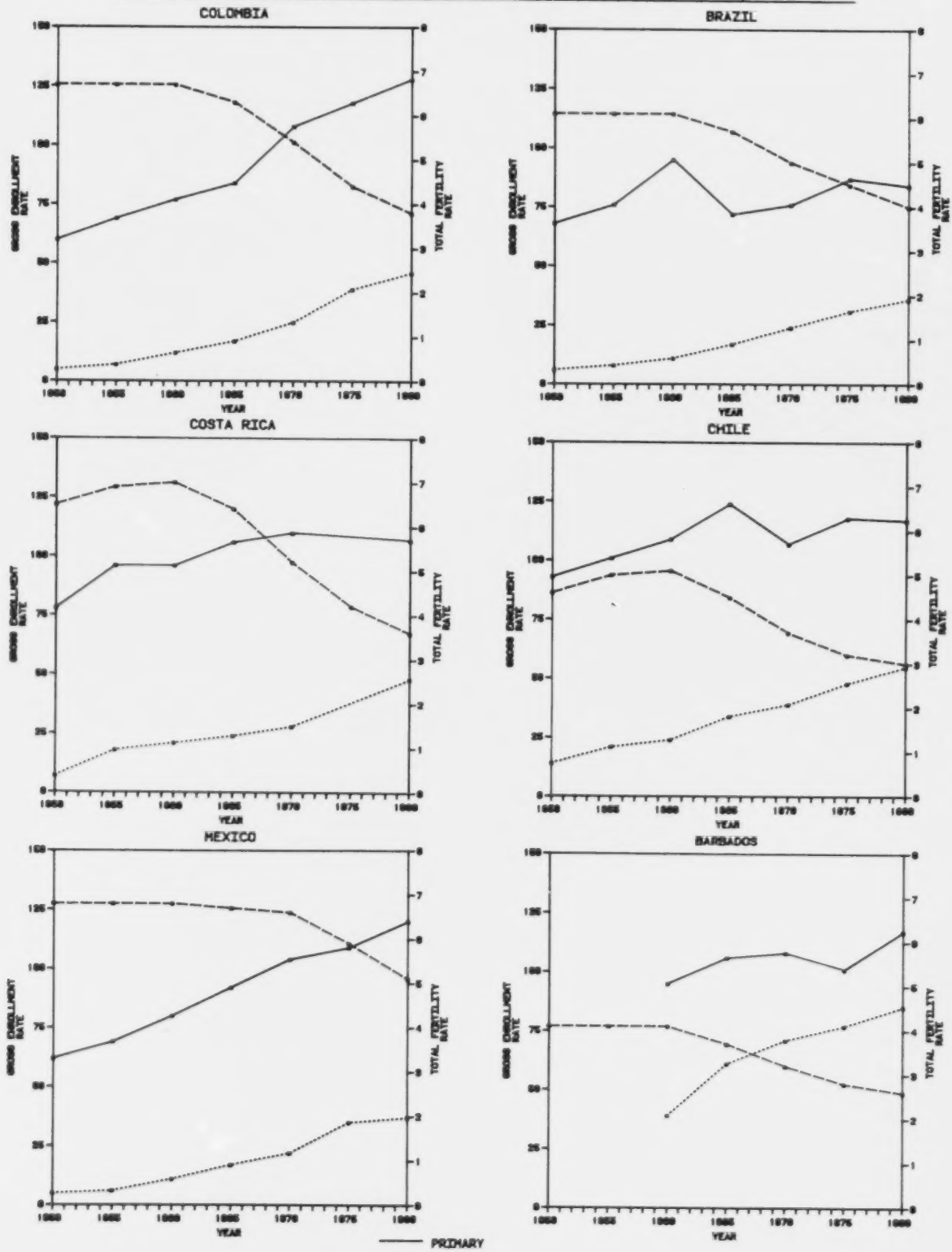

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Figure 3: Fertility and Enrollment Trends in Asia, 1950-1980

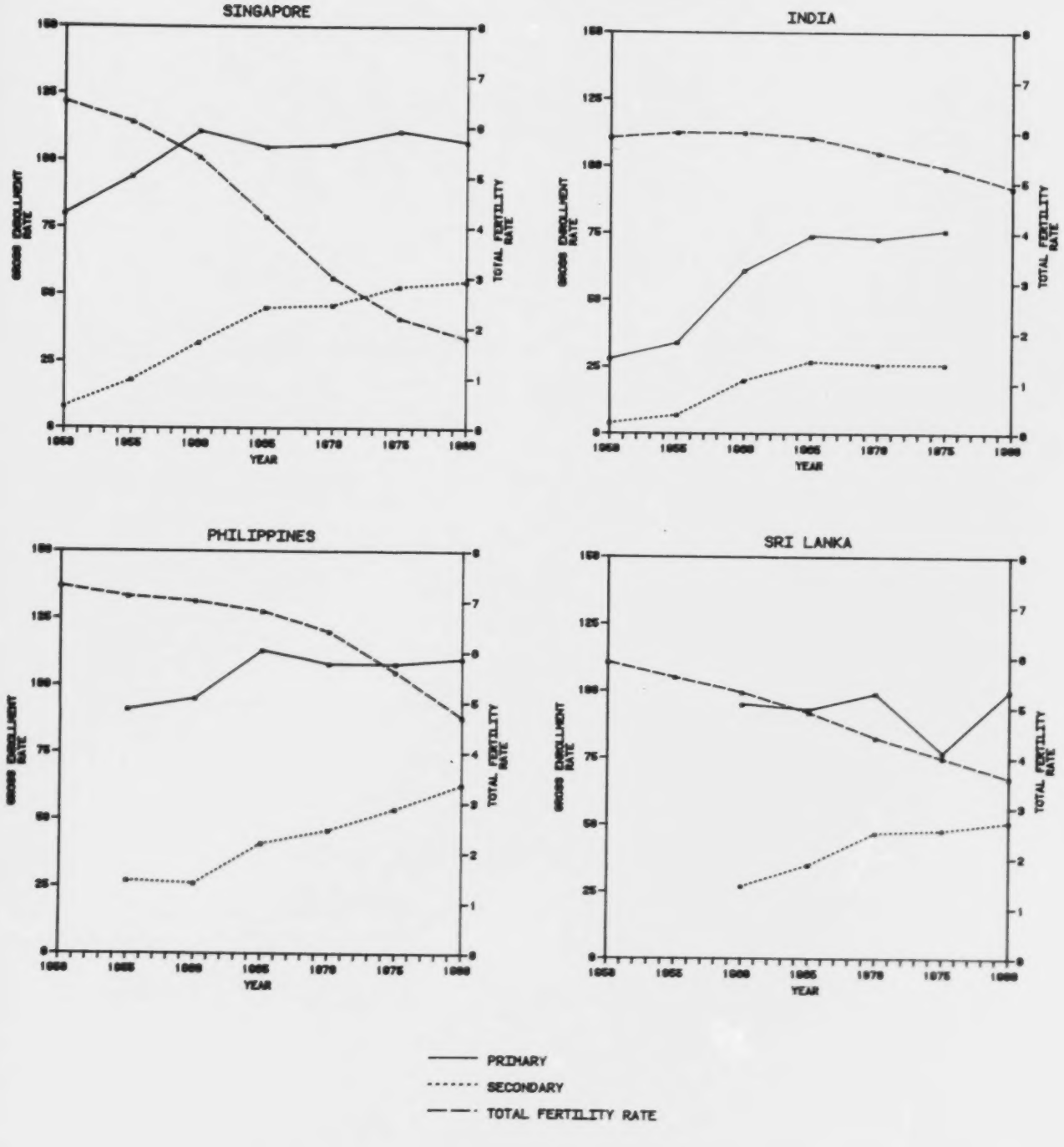

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Figure 3: Continued

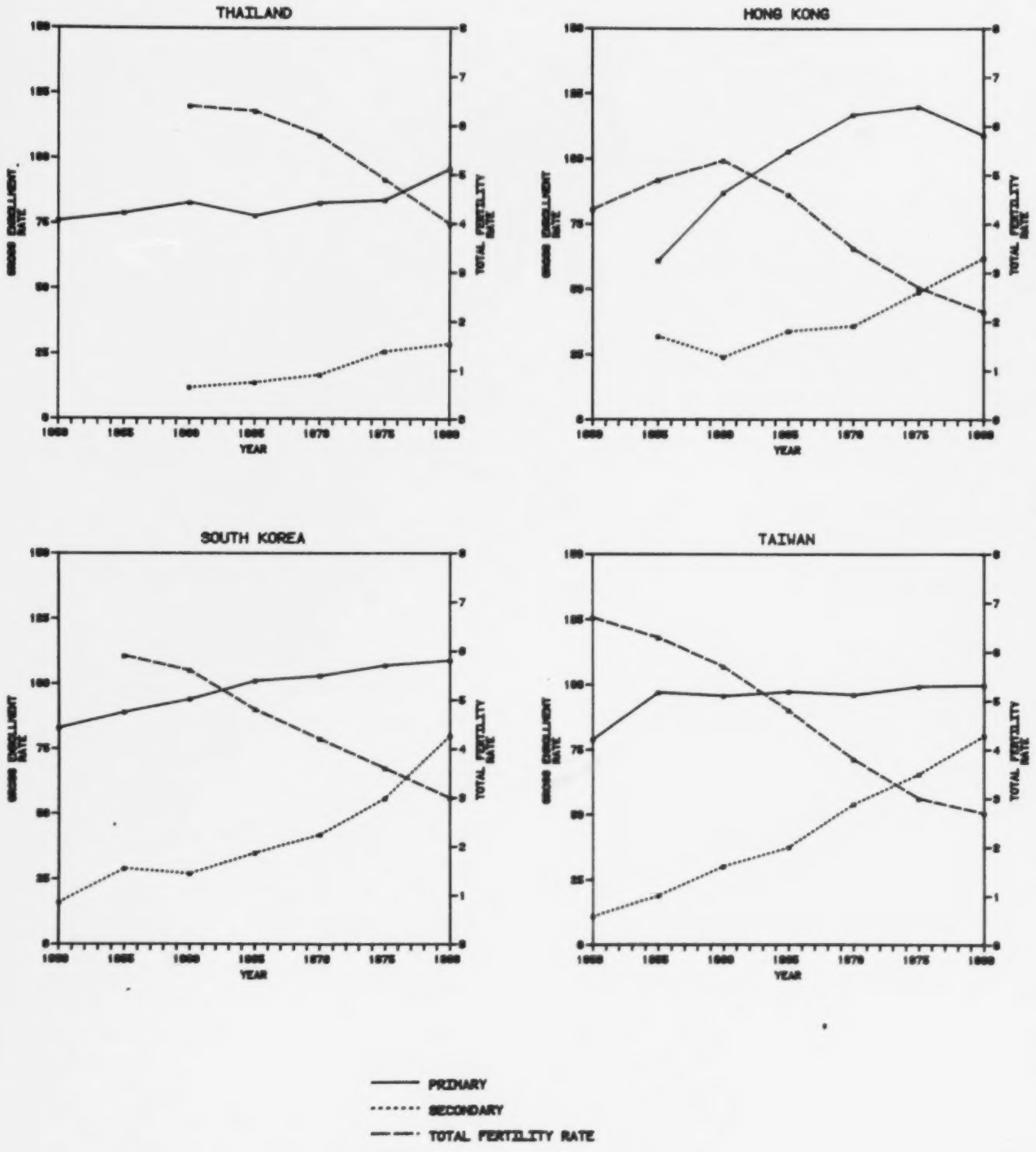

Figure 4: Fertility and Enrollment Trends in Africa, 1950-1980

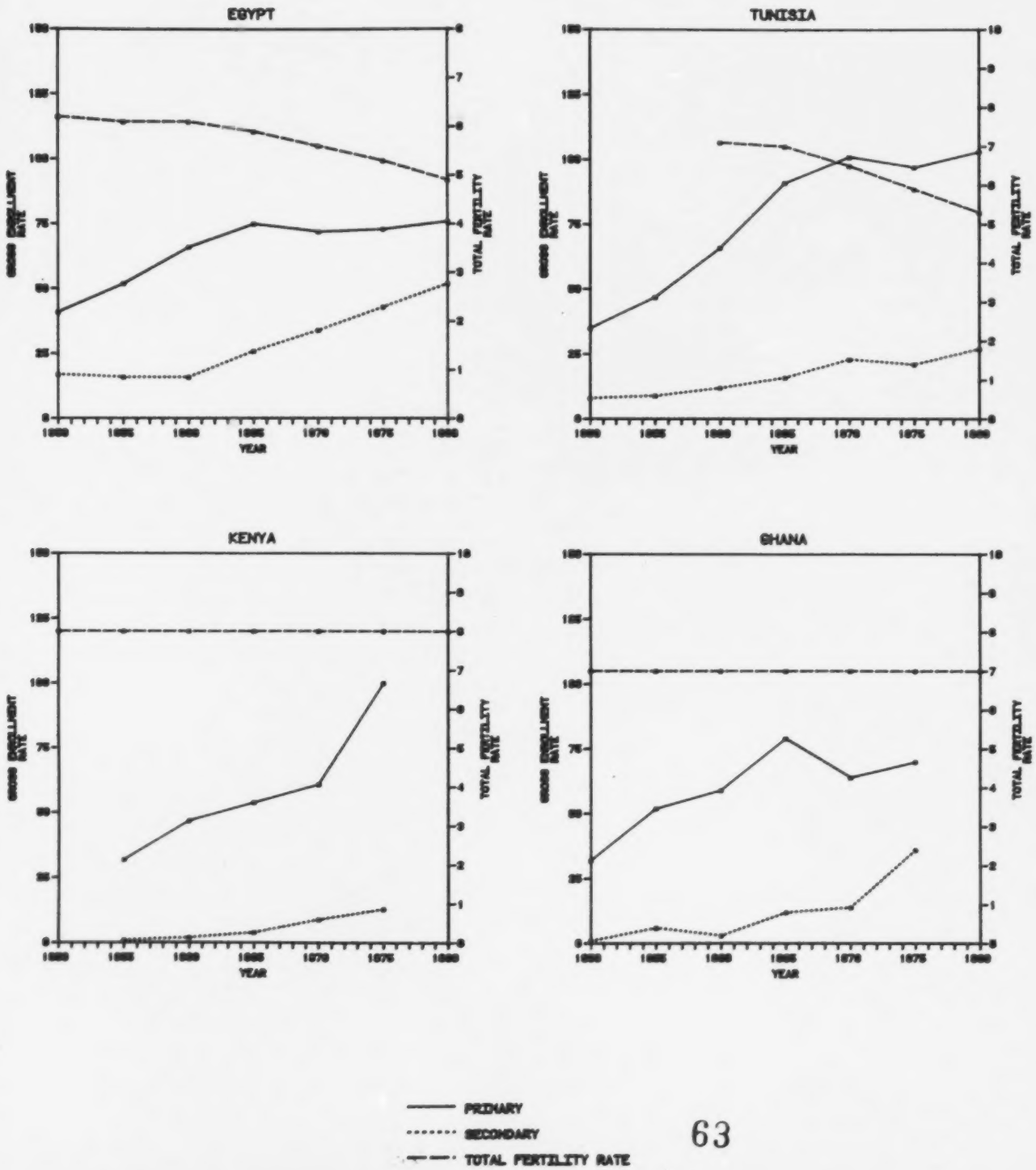

Table 6: Gross Enrollment Levels at the Start of Fertility Decline in Selected LDCs.

	Start of Fertility Decline 1/	GER at Start of Fertility Decline	
		Primary	Secondary
American Samoa	1964	92	85
Bahamas	1970	153	76
Bahrain	1966	118	42
Barbados	1963	80	36
Brazil	1962	108	15
Kampachea (Cambodia)	1968	84	10
Cape Verde	1961	70	8
Chile	1961	105	25
Taiwan	1957	100	24
Colombia	1962	83	14
Costa Rica	1961	100	27
Cuba	1967	118	25
Dominican Republic	1966	91	15
Fiji	1966	85	20
Grenada	1964	156	21
Guadeloupe	1968	148	37
Guam	1961	100	90
Guyana	1961	117	44
Hong Kong	1961	92	30
Jamaica	1971	85	59
S. Korea	1959	96	27
Lebanon	1965	104	22
Malaysia	1962	84	27
Martinique	1969	146	47
Mauritius	1960	98	24
Mexico	1971	104	22
Panama	1968	103	39
Philippines	1969	114	50
Puerto Rico	1961	114	70
Reunion	1960	126	20
Singapore	1955	94	18
Sri Lanka	1963	94	31
Surinam	1972	100	38
Thailand	1968	81	13
Trinidad & Tobago	1960	128	14
Tunisia	1968	107	20
Turkey	1972	106	29
Venezuela	1963	95	30
AVERAGE	--	105	33

1/ Source: Bulatao, R.A. (1983) "Mortality Thresholds For Fertility Transition in Developing Countries". World Bank mimeograph.

2/ Source: Unesco Statistical Yearbook 1970 and 1977.
Some data do not correspond exactly to the start of the fertility decline. They refer to one year earlier for Kampachea, Cape Verde, Chile, Costa Rica, Fiji, Hong Kong, Jamaica, Martinique and Mexico; two years earlier for Bahamas, and Surinam; one year later for Barbados, S. Korea, Philippines, and Turkey; two years later for Venezuela; three years later for Malaysia; four years later for Guyana and Puerto Rico; between 1955-60 for Taiwan, China; and between 1960-65 for Brazil and Sri Lanka.

Table 6 provides corroborating evidence supporting the idea that a threshold in primary school enrollment is usually reached before a sustained decline in fertility takes place. The dates at which fertility start declining have been derived by Bulatao (1983) based on assessment of the level and rate of decline. The data show that at the onset of decline, most LDCs were either fairly well on their way to attaining universal primary education, or had already attained it. Thus only eight of the 39 LDCs had a primary GER below 90 percent at the time of fertility decline, and the lowest GER among these countries was 70 percent, for Cape Verde. At the secondary level however, a threshold condition is much less apparent, given the greater variation in enrollment ratios. If it exists, the threshold would be lower since the average secondary GER at the start of fertility decline was only 33 percent compared to 103 perent at the primary level.

To summarize, there is some indication that in the LDCs the quantity-quality trade-off exists at best weakly in the early stages of development when child-quality investments refer mainly to primary schooling. However, in the more advanced LDCs where universal primary education has been more or less established, declines in fertility are invariably associated with rising secondary school enrollment. This pattern of relationships probably reflects various characteristics of schooling at the primary and secondary levels, including cost considerations. In addition, differences in financial arrangements and in parental aspirations for children's education at various stages of development are also likely to affect the nature of the quantity-quality relationship. Some of these factors are discussed below.

4.4 The Private Cost of Education

What economic burden is borne by families when children are sent to school? To answer this question, we need at least to know the unit private cost of education, that is, the cost to households of each child - year of schooling at different levels of education. Some of this information is given below; however, since there are many gaps in the available data, we can at best only develop some generalisations on private costs which are possibly applicable to LDCs as a whole. Clearly, the results require confirmation by more detailed study. The data presented below pertain solely to primary and secondary schooling, as enrollment at those levels represent the bulk of the school population in LDCs.

(i) Direct Costs

In public primary schools, the available data indicate that students are normally required to pay only a nominal fee, if at all. For example, in 1983 Malawian primary students pay annually between US$3 to US$5 in the lower grades and between US$6 to US$7.50 in the upper grades, depending on urban-rural locality. These rates represent an increase of about 15 to 50 percent from the rates in 1982 which have been unchanged since 1975 [Thobani, 1982]. In Haiti, annual tuition fees at the primary level have remained at US$2.50 for at least 10 years.7/ In some countries, students are exempt from fees; for example, in Indonesia, fees were abolished in 1977 for grades I to III, and in 1978 for grades IV to VI [Meesook, 1983]. Similarly, in Francophone African countries, students not only attend school free-of-charge (at least theoretically), but they are

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7/ Personel communication from M. Ainsworth.

also given free books and writing supplies [Ainsworth, 1983], and sometimes even free school meals. There seem to be no data on the cost of other school-related items 8/, but at the primary level, these are likely to be small, since students normally use few books, walk to school, and eat at home. Moreover, the cost of uniforms is probably also low, since they are not always required, and, if required, the rule is not always enforced. Thus students who cannot afford uniforms can still attend school in clothes worn at other times. Another schooling cost item is parents' contribution to parent-teacher associations or similar organisations; these contributions, usually used to maintain school buildings or to erect new ones, are often voluntary,and may be made in the form of cash, labor or materials.

In most countries, the low private cost of public primary schooling reflects governments' deliberate policy to encourage enrollment. Widespread primary education is viewed not only as a desirable social goal, but also as essential to economic growth [Psacharopoulos, 1982]. Indeed, there is a feeling that as a basic right in life, education should be completely free-of-charge. For example, at the United Nations' thirty-seventh session in March, 1983, the General Assembly urged "all states to consider the adoption of appropriate legislative, administrative and other measures, including material guarantees in order to ensure full implementation of the right to universal education, through, inter-alia free and compulsory primary education, universal and gradually free-of-charge secondary education..."

8/ Some data for Malawi have been gathered in early 1983; they are currently being analyzed.

The material cost of public primary education is thus borne largely by public expenditure. On average, in 1975, more than 15 percent of the national budget in LDCs that was allocated to education went to primary schooling [World Bank, 1980]. Nevertheless, even with this level of spending, the public school system cannot absorb all students wishing to enroll. There is thus some tendency to stretch the available resources by spending less per student. The resulting low school quality, together with lack of places, probably leads some parents to enroll their children in private schools. Where these are subsidized by the government, the private cost of attending is kept low; but usually private schools charge high fees and require students to purchase all their schooling needs. However, at the primary level private school enrollment in LDCs is small, except in Eastern Africa, and declining over time since 1965 [Tan, 1983a]9/.

At the secondary level, the private cost of public schooling varies widely from country to country. In general, however, it is at least as high as for primary schooling, but more usually it is much higher. In terms of fees alone, students pay substantially more; for example, in Indonesia in 1981, these amount to about US$9 for lower secondary students, and about US$18 for upper secondary students whereas in primary schools, no fees are charged [Meesook, 1983]. Similarly, tuition charges range from US$15 to US$75 for secondary students in Botswana, Burundi, Lesotho, Malawi, Sierra Leone, and Zimbabwe, whereas primary students either pay no tuition (Botswana, Burundi, Lesotho, and Zimbabwe) or pay only a nominal

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9/ In 1975, private enrollment at the primary level in LDCs was 43 percent in Eastern Africa, 18 percent in Western Africa, 13 percent in Asia and Latin America and Caribbean, and 6 percent in Europe, Middle East and North Africa.

fee - US$1 in Sierra Leone, and less than US$8 in Malawi.10/ In Korea, the difference in secondary and primary school fees is even larger; in 1980, tuition for middle school ranges from US$100 to US$189, and for general high school from US$166 to US$293 compared to US$5 to US$8 at primary school.

Secondary students in some countries are not required to pay tuition, such as in Guinea, Mali, Mauritania, Mauritius, Swaziland, Tanzania, Upper Volta and Yemen Arab Republic; but there are other expenses. In Tanzania, a 1981 survey of 4,181 students in the last year of secondary schools revealed that those attending tuition-free state schools spent US$139 per student for books, writing supplies, equipment, transportation, uniforms, bedding and incidentals [Tan, 1983b]. Another 1981 survey of Colombian students in secondary schools showed that fees11/ account only for approximately 20 percent of total student expenditure [Hinchliffe, 1983]. A study of 1,832 Indonesian students [Tjiptosamito and Cummings, 1981] indicates that tuition charges make up only 13 to 15 percent of the total private direct cost of attending secondary school.

Moreover, since the relative scarcity of secondary schools requires many students to board at school, additional expenses are often incurred; for example, in 1981 boarding fees amounted to about US$83-290 in Zimbabwe, and about US$83-110 in Malawi. In both countries, these charges

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10/ The data for most of these countries are found in (Ainsworth, 1983). The author has graciously made available data which have been painstakingly collected.

11/ Including registration, tuition, insurance and parent association contributions.

were at least two and a half times tuition fees. Indeed, of the 23 countries for which data are available, only in Mauritania do students truly enjoy nearly free public education, since the government provides textbooks, notebooks, pens, transportation, boarding and medical care [Ainsworth, 1983, Appendix A]. There is also some evidence from the Indonesian study cited above that non-fee expenses are higher for older secondary students. For example, upper secondary pupils spent about twice as much as their lower secondary peers. Their expenditure is higher, not only on average, but also for every item of expenditure. Although the findings cannot form a strong basis for generalization, it is probably true that as a student progresses to higher grades in the first two levels of education, the annual private direct cost of schooling also increases.

The preceeding paragraphs show that students incur significant expenses in public secondary school; but if their expenses are high, they are even higher for students attending private schools. For example, in Colombia, private school fees in 1981 were six to fourteen times as high as in public schools at the same level of instruction [Hinchliffe, 1983]. In addition, the cost of most other schooling needs are also higher; as a result,,the overall expenses of private secondary students can be many times that at public schools. In Colombia, the total private cost is about two to three times higher, and in Tanzania, it is over three times higher.

Despite the large cost difference, however, private schools in LDCs absorb a large proportion of the secondary school enrollment compared to primary enrollment.12/ The dominance of private schools partly

12/ In 1975, private enrollment at the secondary level in LDCs was 45 percent in Eastern Africa; 30 percent in Western Africa; 29 percent in Asia; 33 percent in Latin America and Caribbean; and 8 percent in Europe, Middle East and North Africa [Tan, 1983a].

reflects the insufficiency of places in the state system, and partly also the public's demand for an alternative system which they consider to be superior. Whatever it reflects, however, the dominance of private schools implies that secondary schooling is very expensive for a substantial number of students. When compared with primary schooling, our data indicate that even for those attending the relatively cheaper public systems, the private direct cost of secondary schooling represents a significantly larger financial outlay.

To return to the question of economic burden on families, there is some indication that enrollment at the primary level probably implies only modest increases in family expenditure on education, given the generally low level of unit private costs. However, as educational aspirations increase, and as families begin sending their children to secondary school, the private financial burden of education is likely to increase substantially, although households can still minimise the burden by choosing different amounts of education for different children in the family. As mentioned before, however, the direct cost of school is only part of the cost consideration; perhaps a more important cost is the value of the labor forgone by children attending school.

(ii) Opportunity Costs

To understand the opportunity costs involved in schooling, it is necessary to examine the economic activities of school-age children. Attendance at school involves an opportunity cost only if it is incompatible with a child's work, either in terms of amount of time spent working, or types of work activity.

According to official statistics, about four percent of the world's population aged 15 or less participated in the labor force in

1975 13/; most of these working children lived in developing countries [Mandelievich, 1979]. Children normally work as unpaid family workers, helping on the family farm or in parents' small workshops and commercial establishments. It is also commonly reported that even when children work for third parties outside the family, employers frequently pay wages not to the working child, but to his or her parents; in 1975, an estimated 80 percent of working children worldwide were unpaid family workers [Mandelievich, 1979]. Data for the same year for Thailand show that this arrangement is almost the sole basis on which children of all ages in the rural areas work. In the urban areas, it is confined largely, but by no means exclusively, to children below age ten.

Children can be found working in almost all sectors of the economy. A relatively small proportion live in urban areas where they normally find employment in the manufacturing and service sectors. Often working in small, informal and unregistered enterprises, their range of activities include packing, labelling, cleaning shoes, guarding parked cars, loading and unloading goods, carrying messages and selling on the streets. But the majority of children who work live in rural areas; hence most working children are engaged in agriculture. In the early 1970's, for example 87 percent of all working children in India were in this sector;in Peru, the corresponding statistic was 57 percent [Mandelievich, 1979]. The following paragraphs discuss in more detail the work of children working in agriculture.

13/ This figure is probably an underestimate since labor force statistics in many countries (i) omit young workers; (ii) exclude those who work and study; (iii) include only full-time workers; and (iv) exclude unpaid family workers. Moreover, the data suffer from reporting problems, since child labor, being clandestine in most countries, is usually concealed.

Cain's [1979] study of a village in Bangladesh provides a detailed analysis of the kinds of rural work that children are capable of performing at different ages. Children aged around six work at tasks which do not require physical maturity, such as gathering fuel, picking chilies, carrying messages, fetching water, and caring for younger children. Boys around age eight or nine assume responsibility for herding cattle and fishing; at age eleven, they begin agricultural work, and by age 14, they are capable of the most demanding types of adult work, for example transplanting paddy. Owing to the sexual division of labor in Bangladesh, girls perform different tasks from boys. In general, Cain's data show that they are active in adult female work such as rice processing and food preparation by age nine or ten.

Although children are initiated into working life in early childhood, their lack of physical stamina prevents them from working the same hours as adults. Cain's study indicates that at age 4-6, children work about one-fifth as long as adults, increasing to one-half as long by ages 7-9, and to three-quarters as long by ages 10-12. Children beyond age 12 work, on average, at least the same hours as adults. There is also some indication that it is only beyond age 12 or 13 that children's work efficiency reaches the level of adults. Most children work on own family farms, owing to the lack of wage employment opportunities. Their labor contribution frees adult family members for off-farm work, but this substitution for male adult work is probably limited in the case of young children below age 12. However, children in the 6-9 age group can and do substitute for women in child care duties.

Hart [1980] presents similar but less detailed data on children's time-use patterns in a rice-growing area in Java, Indonesia. As in rural

Bangladesh, children perform work as early as at six years old. In contrast, however, the time spent by children is not as high; for example, in both the peak and slack seasons children aged 10 to 15 work on average only 40 to 60 percent as many hours per month as do adults. Among the poorest agricultural families however, children's labor participation is higher, particularly for females, probably reflecting the lower school attendance rate of children in this socio-economic class. For children aged 6 to 9 the time spent on work, including income-earning activities and housework,is almost negligible compared to adults; this result is true in all households, whether rich or poor, thus suggesting that at these young ages, children's low labor participation is probably associated more with their physical incapacity for adult work than with school attendance. Nag et. al. [1980] also provide data on the average daily time input by children in Nepal and another village in Java. As before, children begin participating in the family's work at early ages, but work only a fraction of the time adults put in, particularly below age eleven. Moreover, their tasks are concentrated in animal care (feeding), child care, and other housework.

Evidence on the compatibility of child labor and schooling is provided in Caldwell et. al. [1981]; their study is based on data from Bangladesh for Dacca, the capital city, and Manikganj, a rural rice growing area. In Manikganj, girls between age seven and eight who attend school work nearly as many hours as those who do not; while for boys, the number of work hours is actually longer for those who attend school. Between ages ten and fourteen, however, children in school work only about half as long as those not in school. However, beyond age fourteen, girls work just as long, while boys work 80 percent as long. In Dacca, the compatibility of

child labor and schooling is very low for all children below age fourteen, possibly reflecting differences in the kinds of work that urban and rural economies generate for children. Beyond age fourteen, however, the work time of children attending school is comparable to those of children not attending school.

In looking at children's pattern of time use, it is also useful to examine the effect of number of siblings on children's work input. Nag et. al. [1980] present data from Java and Nepal which show that time spent on work was higher for children with two or more siblings than for those with fewer. They suggest that possibly in larger families, (i) the presence of elder siblings encourage other children's work participation, and (ii) younger siblings are expected to take over household chores so as to free older siblings for directly productive activities.

The findings for Java and Nepal are however, contradicted by the result of studies in two other LDCs. Mueller [1981] found that in Botswana, as the sibling number increases, the economic work of each child is reduced, while average school hours increases; in the author's view, this finding is consistent with the possibility that children in large families can provide the needed work input, and still have time left for school.

Presumably, the demand for child labor on the family farm does not increasein proportion with increases in the number of children in the household. In another study, De Tray [1982] showed that in Malaysia, the larger the number of children aged over ten in the family, the less each child in the 5 to 14 age group engages in economic and housework; however, his analysis also showed that the larger the number of children under 10, the more each child age 5 to 14 works.

At this point,the available data provide no convincing evidence either for a negative or positive relationship between number of siblings and work per child. Clearly some of the differences in research findings may be attributed to definitional or methodological differences, for example, using different age groupings. For the present purposes, however, the central result of time-use studies is that children perform a significant amount of work, which suggests that sending them to school involves some opportunity costs to the family. However, these costs are low for younger children, say below ten years old, since the kinds of work done by these children are probably not incompatible with attending school; moreover, owing to their lack of physical strength, they typically spend only a few hours working, so that even if time from work is lost, the sacrifice is relatively small. Clearly, these remarks are not applicable in the case of older children. In terms of level of education, the opportunity costs of primary schooling, particularly in the first few grades is low, but increase as the child enters higher grades; and entry into secondary school usually entails a dramatic cost increase.

What do the data on private direct and opportunity costs of schooling suggest for the relationship between fertility and child investments? It probably depends to some extent on parent's aspirations for their children's education. At low levels of development and in rural populations, these aspirations may only mean a desire to see their children able to read and write. Thus in reckoning the cost of child quality investments, parents probably focus largely on the cost of primary schooling. Since this cost is relatively small, the decision to enroll children in school may not have any appreciable effect on the number of

children parents choose to have. Over time as the general level of education in the population rises, and as parents recognize the need for their children to have at least completed primary school, the cost consideration of child quality investments becomes increasingly important. Thus it is probably only at this stage that households, in making fertility decisions recognise a trade-off between number of children and schooling per child. Clearly, cost is not the only consideration, as many researchers have emphasized. In particular, if parents can rely on some of the older children for financial help to send younger children to school, the quantity-quality trade-off model may not be the appropriate framework for describing fertility decision-making in such households; some evidence for such financial arrangements are briefly discussed below.

4.5 Private Returns to Schooling

Having considered the private cost of education, we now turn to examine its private returns to individuals and their families. In calculating these returns, economists have generally used individuals' earnings as the yardstick of benefits associated with attending school. Clearly this approach is flawed, as it discounts the fact that education provides a host of other not-easily-quantified benefits, such as ability to appreciate literature and art better. However, since the focus of this paper is not on measurement, we shall merely note that rates of return calculated on the basis of earnings data represent lower bound evaluations of the total benefits to schooling.

That individuals gain from attending school is hardly debatable; research findings corroborate casual observation that educated individuals earn more than those who are not. In a recent study, Psacharopoulos [1981] provided a compilation of rate-of-return data for over 40 countries. These data reveal that everywhere in the developing world, the private returns to education, particularly for primary schooling are generally high, and, almost without fail, exceed the 10 percent commonly associated with the opportunity cost of capital. Moreover, time series data, which are available only for USA and Colombia, indicate that these returns remain highly attractive over time despite the rapid expansion of education. The reason is because with development and technological change, the demand for educated labor keeps pace with the rapidly growing supply.

Although individuals gain personally from being educated, the decision to enroll, particularly at the primary and secondary levels, is probably made by their parents, and not the individuals themselves. What are parents' motivations in sending a child to school? Clearly at one

level, it is because education is perceived to be a viable vehicle of upward social mobility for the child. Even if parents are less altruistic, the fact is that as society becomes technologically more complex, and as more people rely on urban employment for a livelihood, it becomes a necessity for children to be at least literate in order to survive economically. As one Indian agricultural laborer explained, "...Nobody needed an illiterate villager...nowadays you need to read and write even for a coolie's job..."[Vlassoff and Vlassoff, 1980]. Over time, it is thus probable that parents' educational aspirations for their children will rise. For example, in a study of a poor rural area in Kerala State in India, Zachariah [1983] found that the average desired years of schooling for children had risen rapidly in all socio-economic groups; even parents who have had no education now wanted their children to obtain some secondary schooling.

The effect of rising educational aspirations on the number of children parents choose to have is not immediately apparent in the context of LDCs. This is because the private returns to schooling typically accrue not only to the individual who went to school, but also to his/her parents and siblings. If education improves employment opportunities and earning power, and if children remit part of their earnings to parents, then it is rational for parents to have and educate many children [Mueller, 1983]. In many developing countries, the custom of remitting earnings to parents is quite common. For example in India, Zachariah's [1983] data indicated that 96 percent of children who worked contributed to the household income. That parents expect financial help from children is also apparent from the data presented in Bulatao [1979]; over 60 percent of sample fathers interviewed in Turkey, the Republic of Korea, the Philippines and Taiwan, China expected

to have a share in their son's salaries. The corresponding percentage was a slightly over 50 percent in Indonesia and Thailand, whereas in Singapore and the USA, it was only 29 and 19 percent respectively. In the longer run, children are also expected to provide old age support. Vlassoff and Vlassoff [1980] showed that in India, over 40 percent of elderly men in their sample indicated that "educated sons help more" when asked to evaluate the support given by educated and uneducated sons. In general, if parents can benefit from having educated children, we may not observe a quantity-quality tradeoff.

Part of the financial help that working children make available to parents typically goes to pay for the cost of educating younger children. In Bulatao's [1979] study, such help is expected from sons by over 80 percent of fathers in the Philippines, Turkey, Indonesia, and Thailand; 79 percent in Taiwan, China; 60 percent in the Republic of Korea; 35 percent in Singapore; compared to only 16 percent in the USA. Expectations of help from daughters were expressed by only slightly lower proportions of the respondents. Moreover, if the sample was separated into high-parity-nonlimiters (HPN) and low-parity-limiters (LPL), the proportion expecting help from sons for siblings' education was always significantly higher among HPN than among LPL, except in Indonesia where it was only slightly lower. These expectations reflect the financial relationships within families which characterise most of Asia and Africa; parents usually pay for the oldest child's education in the expectation that he or she will contribute towards the schooling expenses of the next sibling, who in turn pays for yet a younger sibling [Mueller, 1983]. It should be noted, however, that this dependence on sibling resources is effective only if the older children start working after a few years of schooling; with rising

educational expectations, and as the normal stay in school lengthens, older children would probably still be in school when their younger siblings reach schooling age. In these circumstances, the financial burden would fall back on the parents, at least until the older children begin working. The web of financial obligations and expectations commonly also extends beyond the nuclear family; it is thus usual to rely on relatives in better circumstances to help with the cost of schooling.

What are the implications of the system of financing described above for the relationship between number of children and their education? Clearly, as long as parents do not expect to bear the full cost of child quality investments, the quantity-quality trade-off will probably be weak if it exists at all. However, with rising educational goals and as kinship ties and family obligations weaken, as they are likely to with modernisation and industrialisation, this trade-off will tend to become stronger as the choice between quantity and quality becomes increasingly inescapable when the cost of child quality investment cannot be shifted elsewhere.

4.6 Other Influences

So far we have discussed parents' decision to enroll children in school on the assumption that it is a voluntary decision, motivated largely by the attractiveness of private returns to schooling. What happens when legislation compels parents to send their children to school and keep them there beyond the age they would have chosen themselves? Would such legislation also indirectly persuade parents to lower their fertility; if so, by what mechanism?

In most LDCs, compulsory schooling laws apply to children of primary school age. These laws are generally marked by several characteristics. Firstly, there are serious enforcement problems, particularly in rural areas where the population is dispersed and the transportation system, weak. Even where the personnel exists to enforce compliance, the lack of school facilities frequently presents an obstacle to accomplishing enrollment goals. As in MDCs, enforcement becomes effective only in an environment where enrollment is already high and rising. In other words, the main effect seems to be to bring a recalcitrant minority into compliance with the general view among parents that children ought to attend school. Secondly, compulsory schooling legislation often contains special provisions to excuse from school children whose parents need them to work; the authorities either tolerate frequent and long absenteeism, or permit non-enrollment in some cases. Moreover, school holidays are normally arranged so that they coincide with harvest and other busy periods during which children are expected to help. These provisions thus minimize the opportunity cost of school attendance. At the same time, to encourage attendance further, the financial cost is

also kept low through the provision of free or nearly free services[14]/.

Compulsory schooling legislation often goes hand in hand with child labor legislation, since each requires the other for reinforcement. Here again, the question is whether these laws lead or lag behind the movement away from child labor usage; do these laws cause a decrease in the demand for child labor, or are they a consequence, formalized as law to compel the compliance of a minority who still profit from the use of child labor? Child employment is caused "most fundamentally [by] the extent and nature of poverty" [Rodgers and Standing, 1981]. As such, a mere piece of legislation, by itself, cannot hope to have much effect. Moreover, whether or not children work depends on "cultural constraints, social relations of production, the industrial and occupational structure, [and] the nature of available technology..."

To summarize, it is probably true that legal provisions at best speed up existing trends in enrollment and child employment. Under a compulsory education law, some parents would undoubtedly be forced to school their children beyond the level they would have chosen. The increase in child quality investment would, however, have an uncertain effect of parents' fertility. Compulsory education is frequently enforced by minimizing both the private direct and opportunity cost of attending schools. If the economic burden is thus shifted away from parents, would they still balance quantity against quality? Since parents nevertheless still bear some cost, the trade-off probably exists, but is likely to be

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14/ For a description of the experience with compulsory schooling legislation in LDCs, see Unesco's series of Studies on Compulsory Education, covering countries such as India, the Philippines, Thailand, The Arab States, and Indonesia.

weak. As for laws against employing children, the main mechanism by which they have an effect is through reduction in the economic value of children to parents, which in turn presumably leads to a reduction in fertility. Here reduction in fertility can only be partly attributed to the effect of child labor legislation since such legislation is not totally responsible for the reduction in child labor practices.

5. Conclusions: Children's Schooling, Demand for Children, and Fertility Change.

This paper has attempted several things. First, the connections between the education of children and the demand for chldren have been explored both in theory and in previous empirical work. Second, the relationship between changes in schooling and changes in fertility has also been studied. Finally, the association between education of children and fertility decline has been viewed, on a basic empirical level, historically for five presently developed countries and also for 18 developing countries since 1950.

Some of the theory predicts a negative association of children's education and fertility. This stems largely from two directions, the human capital, quantity-quality tradeoff, extensively elaborated by Gary Becker, and the intergenerational transfer model of J.C. Caldwell. While these models are useful, they need to be subjected to modification based on specific circumstances. (See, for example, the qualifications noted by Mueller (1983)). The effect of schooling of children operates through direct and indirect (opportunity) costs as well as changes in expected future returns to education. The process of economic development and modernization generally raises the undiscounted returns to education. Direct private costs (in real terms) often decline, due to increased government intervention and financing of education. Indirect costs (foregone earnings of children) may rise, although compulsory schooling laws and child labor legislation can reduce these costs.

In the earliest stages of development, during which investment in children is mainly primary schooling, there may be only a weak negative relationship, or even a positive relationship, between children's education and fertility. If price and/or income elasticities for child quality are

smaller than those for child quantity, if direct or indirect education costs are low, (e.g. if only young children attend primary school); if there are economies of scale in financing of education within the household (e.g. older children paying for younger children); if child mortality is high; or if returns to education are relatively low, then the relationship can weaken or turn postitive. These conditions are more likely to prevail in low income agrarian societies than in higher income urban environments.

The data presented in this paper are consistent with the theory. Historically for developed countries and more recently for developing countries there seemed to have been little relationship between levels or change in primary school enrollments until primary gross enrollment ratios (GER's) reached a level of about 70-80% of children in the relevant age categories. There were exceptions (such as the United States in the nineteenth century and Thailand since 1960), but, overall, a high level of primary GER seems important to a decline in fertility. At earlier stages of development, with lower parental aspirations for education, most schooling consisting of only a few years of primary education, low direct economic burdens per child year of schooling, low opportunity costs for young children in school, and with older children or relatives often sharing direct costs, the relationship of schooling to fertility is likely to be weak. The direction and strength of the relationship depends both on economic and cultural conditions.

When, however, a society reaches a certain level of development, with accompanying rising incomes and levels of urbanization, then the relationship seems to strengthen. It is likely that high levels of primary GER's are symptomatic of rising returns to education (and a

consequent decline in the price of child quality). At this point, many parents begin to plan for more years of children's education. The longer gestation period, together with rising unit costs at higher levels of education, imply that anticipated child quality investments involve an escalating economic burden. Kinship ties and sibling obligations often change and weaken in the process of development, placing the direct costs of children more fully on parents. Factors leading to declining costs of education, such as compulsory schooling and child labor laws (operating on indirect costs) as well as increased public support of education (operating on direct costs), would most likely operate at the primary level than at the secondary level. Once parents begin to demand greater amounts of education for their children, which is more likely to occur at higher levels of income and development, the conflict between large families and child quality becomes greater. Education costs increase rapidly, particularly because the opportunity cost of children's education is much higher for children in secondary school ages, but also because direct secondary school costs are more likely to fall on parents and families. Alternatively, under Caldwell's model, as children begin to obtain more secondary education, the direction of the net flow of resources between parents and children changes in favor of children, and parents begin to reduce fertility. This is again consistent with the data which indicate fertility decline associated with rising secondary GER's, in a situation in which universal primary education was either already established or being approached.

A recent study by Anker (1978) has produced results consistent with the quantity-quality tradeoff. The study used country level data from 69 LDC's for 1968-70, measured child quality investment as the

secondary school enrollment rate, and estimated a simultaneous structural model. His two stage least squares estimates of the model indicated that, ceteris paribus, a ten percent rise in the secondary school enrollment ratio would be accompanied by a 1.2 percent drop in fertility. This relationship was statistically significant at a ten percent level. The study also noted that, at early stages of development, rising life expectation at birth and falling female labor force participation tended partially to offset the negative effect on fertility of rising adult literacy, school enrollment, and non-agricultural employment. At intermediate levels of development these relationships became more uniformly negative.

This paper has been exploratory and descriptive in nature. It attempts to delineate the relationship of demand for children and fertility to the education of children, both at the primary and the secondary levels. Although the present findings are tentative, they are suggestive and indicate a strategy for additional research on this topic.

Appendix A

The Becker-Lewis Quantity-Quality Tradeoff Fertility Model

Let a family have a utility function, which it seeks to maximize.

(1) $U = U(n, q, Z_1, Z_2 \ldots\ldots Z_m)$

where U is family utility; n is number of children; q is expenditures per child, called total child quality per child; and Z_1's are the quantities of other "commodities" (which are actually outputs of household production functions which themselves use marketed goods and services). The Z_1's can be written as a composite commodity Z for convenience. Thus

(1.1) $U = U(n, q, Z)$

This utility function is maximized subject to a full income budget constraint.

(2) $I = P_c \cdot q \cdot n + \Pi_z Z$

where I is full income, P_c is the constant cost of a unit of quality, Π_z is the cost of Z, and $P_c \cdot q\, n$ is the total amount spent on children. It is non-linear in n and q, and it is this non-linearity which creates the quantity-quality interaction.

Maximizing (1.1) subject to (2) yields the following first order equilibrium conditions.

$$(3)\quad \begin{cases} \dfrac{\partial U}{\partial n} = MU_n = \lambda P_c q = \lambda \Pi_n \\ \dfrac{\partial U}{\partial q} = MU_q = \lambda P_c n = \lambda \Pi_q \\ \dfrac{\partial U}{\partial z} = MU_z = \lambda \Pi_z \end{cases}$$

where Π_n is the shadow price of n and Π_q is the shadow price of q. What is interesting is that Π_n depends on q (i.e. the shadow price of quantity depends on total quality per child) and that Π_q depends on n (i.e. the shadow price of quality depends on total quantity). In particular, this means that an increase in quality per child (q) will raise the price of quantity (Π_n) by raising the cost of each child. From (2) and (3), demand functions for n, q, and Z can be derived as a function of shadow prices and income.

$$(4)\quad \begin{cases} n = d_n(\Pi_n, \Pi_q, \Pi_z, R) \\ q = d_q(\Pi_n, \Pi_q, \Pi_z, R) \\ z = d_z(\Pi_n, \Pi_q, \Pi_z, R) \end{cases}$$

where R is full shadow income (i.e. the shadow amounts spent on the different commodities).

$$R = (P_c n)\, q + (P_c q)\, n + \Pi_z Z$$

$$= \Pi_q q + \Pi_n N + \Pi_z Z$$

In general, $\frac{\partial n}{\partial q} < 0$ because $\frac{\partial n}{\partial \Pi_n} < 0$ and $\frac{\partial \Pi_n}{\partial q} > 0$.

Economic development can raise rates of return on education and training, particularly in urban areas. This, in turn, lowers the marginal cost of quality ($MC_q = \Pi_q$, in competitive equilibrium), and hence raises demand for quality which, in turn, lowers demand for quantity of children. In fact, in this system, anything which reduces the marginal cost (and price) of child quality, such as schooling subsidies, can reduce the demand for quantity [Becker, 1981, ch. 5].

Appendix Tables A.1 - A.5 /1

(Fertility, Mortality and enrollment data for five developed countries).

/1 The rates are generally calculated for a three year average around the census data. Symbols in the tables have the following definitions:

I_f = Coale's index of overall fertility.

I_g = Coale's index of marital fertility.

I_m = Coale's index of proportions nmarried.

I_h = Coale's index of illegitimate fertility.

TFR = Total fertility rate.

NRR = Net reproduction rate.

CBR = Crude birth rate (per 1000).

q(15)= Probability of death between birth and age 15.

IMR = Infant mortality rate (per 1000).

CDR = Crude death rate (per 1000).

Table A.1: Demographic and School Enrollment Data: England & Wales, 1851-1971

Date	Fertility							Mortality			Gross Enrollment Rates (per 100)		
	I_f	I_g	I_m	I_h	TFR	NRR	CBR	q(15)	IMR	CDR	Primary Enrollment/ Children 5-14	Primary & Secondary/ Children 5-19	Secondary Enrollment/ Children 10-19
1851	.349	.675	.483	.045	4.663	-	34.08	-	157.7	21.77	8.06	-	-
1861	.359	.670	.502	.046	4.524	1.366	34.59	.30829	178.1	21.61	18.0	-	-
1871	.369	.686	.509	.041	4.670	1.41	34.98	.31103	182.4	22.59	26.3	-	-
1881	.355	.674	.501	.034	4.552	1.54	33.92	.24991	145.8	18.88	50.5	-	-
1891	.310	.621	.477	.026	4.080	1.36	31.42	.27040	176.7	20.21	59.0	-	-
1901	.273	.553	.476	.021	3.449	1.21	28.51	.24907	176.6	16.91	71.9	49.7	1.44
1911	.234	.467	.479	.019	2.897	1.075	24.40	.21434	146.5	14.61	74.7	52.6	2.44
1921	.193	.375	.489	.018	2.685	1.09	22.40	.13933	88.4	12.10	72.1	51.7	4.87
1931	.154	.292	.503	.014	1.882	0.79	15.80	.11089	70.1	12.29	76.5	54.4	6.44
1941	.147	-	-	-	1.736	0.745	14.95	.09565	63.0	13.54	-	-	-
1951	.174	.251	.658	.025	2.170	1.01	15.59	.03866	29.5	11.85	70.6	68.8	31.8
1961	.217	.292	.699	.043	2.777	1.305	17.58	.02883	22.4	11.81	59.2	68.2	40.6
1971	-	-	-	-	-	-	-	-	-	-	69.4	82.1	53.2

Sources: (1) I_f, I_g, I_m, I_h: 1851-1931: Data from the European Fertility Project, Princeton University.
1941: Calculated from data in Keyfitz & Flieger (1968).
1951-1961: Calculated from data in Mitchell & Jones (1974).

(2) TFR & NRR: 1851: Glass (1938).
1861-1961: Keyfitz & Flieger (1968).

(3) CBR: 1851: Mitchell (1975).
1861-1961: Keyfitz & Flieger (1968).

(4) q(15), IMR, CDR: 1851: Mitchell (1975).
1861-1961: Keyfitz & Flieger (1968).

(5) School enrollment data: Mitchell (1975). U.S. Bureau of the Census (1974, 1976).

(6) School age population: Mitchell (1975).
United Nations (1979b).

Table A.2: Demographic and School Enrollment Data: Germany, 1867-1970

Date	Fertility					Mortality			Gross Enrollment Rates (per 100)		
	I_f	I_g	I_m	I_h	CBR	q(15)	IMR	CDR	Secondary Enrollment/ Children 10-19	Primary Enrollment/ Children 5-14	Prim. & Second. Enrollment/ Children 5-19
1867	.389	.761	.454	.079	37.2	-	307	28.1	-	-	-
1871	.396	.760	.472	.071	37.5	-	310	28.7	1.31	64.1	45.9
1875	.428	.791	.495	.073	40.5	.37600	256	26.9	-	-	-
1880	.404	.735	.501	.072	38.2	-	227	25.7	2.57	69.5	50.3
1885	.395	.726	.494	.073	37.1	.36200	232	26.0	-	-	-
1890	.389	.706	.497	.070	36.4	-	224	23.8	3.59	74.0	53.8
1895	-	-	-	-	36.1	.32000	219	21.7	-	-	-
1900	.373	.664	.513	.066	35.7	-	217	21.4	4.53	72.6	53.5
1905	-	-	-	-	33.4	.26600	195	19.2	-	-	-
1910	.312	.542	.524	.059	29.8	.23500	175	16.9	4.87	71.2	52.6
1925	.185	.334	.490	.041	20.3	.14300	105	11.9	6.16	75.9	51.0
1933	.157	.264	.534	.033	15.9	.10800	74	11.0	7.52	71.9	57.4
1939	.202	.316	.590	.038	20.1	-	65	12.2	5.58	82.1	55.4
1950	.173	.291	.537	.035	16.2	-	56	10.6	12.2	78.0	62.6
1961	.200	.301	.625	.032	17.8	.04328	15	11.4	16.7	69.8	58.2
1970 a/	-	-	-	-	-	-	-	-	52.1	67.9	80.1

a/ Federal Republic of Germany.

Sources: (1) I_f, I_g, I_m, I_h: 1867-1939: Knodel (1974) 1950-1961: Data provided by European Fertility Project, Princeton University.
(2) CBR: Mitchell (1975).
(3) q(15): 1875-1933: Knodel (1974).
1961: Keyfitz & Flieger (1968).
(4) IMR, CDR: Mitchell (1975).
(5) School enrollment data: Banks (1971), U.S. Bureau of the Census (1974).
(6) School age population: Mitchell (1975), United Nations (1979b).

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Table A.3: Demographic and School Enrollment Data: Sweden, 1800-1970

Date	Fertility							Mortality			Gross Enrollment Rates (per 100)		
	I_f	I_g	I_m	I_h	TFR	NRR	CBR	q(15)	IMR	CDR	Secondary Enrollment/ Children 10-19	Primary Enrollment/ Children 5-14	Prim. & Second. Enrollment/ Children 5-19
1800	.334	.688	.458	.034	4.164	1.15	31.21	.36867	249.0	25.88	-	-	-
1810	.323	.676	.447	.038	4.275	1.02	32.20	.42915	260.1	33.09	-	-	-
1820	.355	.714	.463	.046	4.519	1.31	34.29	.33446	206.7	24.90	-	-	-
1830	.357	.671	.498	.045	4.523	1.346	32.52	.31999	204.0	25.82	-	-	-
1840	.324	.678	.441	.044	4.405	1.38	30.54	.28666	184.6	21.73	-	-	-
1850	.315	.673	.425	.050	4.305	1.39	31.46	.27384	165.6	20.54	-	-	-
1860	.343	.709	.440	.055	4.558	1.46	34.10	.28376	150.1	19.87	-	-	-
1870	.329	.709	.416	.058	4.120	1.33	29.15	.27564	157.7	19.40	-	56.8	-
1880	.321	.704	.409	.055	4.317	1.43	29.52	.25962	131.3	17.56	1.34[a]	69.3[a]	47.5[a]
1890	.316	.674	.421	.057	4.098	1.44	27.92	.21359	115.9	16.75	1.52	68.2	48.8
1900	.297	.639	.411	.059	3.984	1.43	26.79	.19144	106.9	16.19	1.77	68.9	48.6
1910	.268	.560	.409	.066	3.574	1.39	24.72	.13533	69.8	14.11	2.26	69.8	49.5
1920	.213	.440	.413	.053	2.852	1.11	20.99	.12393	46.4	14.19	2.96	60.7	43.0
1930	.151	.301	.422	.041	1.913	0.813	15.20	.08638	42.6	12.01	3.80	62.6	43.7
1940	.194	.294	.586	.044	1.916	0.86	15.76	.05756	31.3	11.14	6.42	63.0	43.7
1950	.187	.269	.628	.049	2.312	1.08	16.64	.03133	18.9	9.85	14.3	62.3	53.0
1960	.178	.252	.626	.053	2.227	1.052	14.02	.02328	15.6	9.82	23.8	67.6	61.0
1970	-	-	-	-	-	-	-	-	-	-	60.9	55.8	77.0

a/ 1982.

Sources: (1) I_f, I_g, I_m, I_h: Data furnished by the European Fertility Project, Princeton University.

(2) TFR, NRR, CBR, q(15), IMR, CDR: Keyfitz and Flieger (1968).

(3) School enrollment data: Mitchell (1975), Banks (1971), U.S. Bureau of the Census (1974).

(4) School age population: Mitchell (1975), United Nations (1975).

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Table A.4: Demographic and School Enrollment Data: United States, 1800-1970

Date	Fertility						Mortality			Enrollment Rates (per 100)		
	TFR I (Whites)	TFR II (Whites)	TFR III (Total)	NRR (Total)	CBR (Total)	CBR (Whites)	q(15)	IMR (Total)	CDR	Secondary Enrollment/ Children 10-19	Primary Enrollment/ Children 5-14	Prim. & Second. Enrollment/ Children 5-19
1800	8.02	7.04	-	-	-	55.0	-	-	-	-	-	-
1810	7.92	6.92	-	-	-	54.3	-	-	-	-	-	-
1820	7.42	6.73	-	-	55.2	52.8	-	-	-	-	-	-
1830	6.93	6.55	-	-	-	51.4	-	-	-	-	-	-
1840	6.56	6.14	-	-	51.8	48.3	-	-	-	-	-	46.9 /c
1850	6.03	5.42	-	-	-	43.3	.34736	229.5	-	-	-	47.2
1860	5.52	5.16	-	-	44.3	41.4	.30457	197.4	-	-	-	50.6
1870	5.13	4.56	-	-	-	38.3	.28455	185.0	(23) /a	0.86	74.0	52.6
1880	4.67	4.25	-	-	39.8	35.2	.33777	225.1	-	3.82	77.5	57.3
1890	4.40	3.93	-	-	-	31.5	.25902	160.9	(19) /b	1.49	85.7	60.1
1900	3.75	3.50	-	-	32.3	30.1	.24234	120.2	16.8	3.27	88.2	63.1
1910	3.61	3.41	-	-	30.0	27.2	.18494	114.6	14.3	5.03	89.4	63.7
1920	3.31	3.14	3.378	1.334	27.3	26.5	.13718	88.8	12.91	13.1	95.4	75.2
1930	-	2.41	2.547	1.072	20.9	20.2	.10202	68.1	11.43	21.0	95.5	78.7
1940	-	2.20	2.312	1.026	19.5	18.7	.07317	54.5	10.64	28.6	97.1	82.5
1950	-	3.04	3.153	1.439	24.5	23.5	.04440	33.9	9.64	31.9	87.9	81.0
1960	-	3.52	3.690	1.732	23.7	22.6	.03484	26.8	9.39	35.7	84.3	83.4
1970	-	-	-	-	-	-	-	-	-	49.9	78.3	86.6

/a 1870/80; /b 1891/1900; /c Whites.

Sources: TFR I: Sanderson (1979).
TFR II: Coale & Zelnick (1963).
TFR III & NRR: Keyfitz and Flieger (1968).
CBR: U.S. Bureau of the Census (1975).
q(15) & IMR: 1850-1900: Haines (1979). Preston & Haines (1981)
1910: Glover (1921).
1920-1960: Keyfitz & Flieger (1968).
CDR: 1870,1890: Kuznets (1966).
1900-1910: U.S. Bureau of the Census (1975).
1920-1960: Keyfitz & Flieger (1968).
School enrollment data: 1840-1850: U.S. Censuses of Population, 1840, 1850, 1860.
1870-1960: Banks (1971).
1970: U.S. Bureau of the Census (1974).
School age population: U.S. Bureau of the Census (1975). United Nations, (1979b).

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Table A.5: Demographic and School Enrollment Data: Japan, 1875-1970

Period/ Year	Fertility							Mortality			School Enrollment Rates (per 100)		
	I_f	I_g	I_m	I_h	TFR	NRR	CBR	q(15)	IMR	CDR	Secondary Enrollment/ Children 10-19	Primary Enrollment/ Children 5-14	Prim. & Second. Enrollment/ Children 5-19
1875/79	-	-	-	-	-	-	25.2	-	-	18.0	-	-	-
1880/84	-	-	-	-	-	-	26.3	-	-	19.5	-	-	-
1885/89	-	-	-	-	-	-	28.3	-	-	21.5	1.31 /g	35.1 /g	25.9 /g
1890/94	-	-	-	-	-	-	28.4	-	-	21.1	-	-	-
1895/99	-	-	-	-	-	-	30.6	.28290/e	157.9/e	20.7	2.74 /e	47.1 /e	33.6 /e
1900/04	-	-	-	-	-	-	32.0	-	-	20.4	-	-	-
1905/09	-	-	-	-	-	-	32.0	.28101/f	162.1/f	20.9	5.82/f	54.8/f	42.4/f
1910/14	-	-	-	-	-	-	33.6	-	-	20.2	-	-	-
1915/19	-	-	-	-	-	-	32.4	-	-	22.5	-	-	-
1920/25	.423/a	.590/a	.697/a	.054/a	-	-	36.7	-	164.7	23.0	2.63/a	65.1/a	47.6/a
1925/30	-	-	-	-	5.342/c	-	34.7	-	140.8	19.8	-	-	-
1930/35	.376/b	.534/b	.677/b	.045/b	4.929/b	-	32.6	-	124.3	18.1	5.23/b	68.7/b	50.8/b
1935/40	-	-	-	-	4.929/d	-	29.3	-	110.4	17.3	-	-	-
1939/41	-	-	-	-	4.134	1.435	29.04	.19138	98.14	16.49	5.89/h	70.3/h	53.0/h
1950/52	.299	.496	.588	.018	3.297	1.393	25.64	.09504	55.95	9.93	41.8/i	61.0/i	49.1/i
1953/55	.199	.346	.566	.008	2.511	1.10	20.34	.07288	44.56	8.29	42.0/j	58.8/j	68.4/j
1959/61	.170	.290	.578	.005	2.013	0.922	17.24	.04722	31.01	7.48	41.4	59.7	69.2
1970	-	-	-	-	-	-	-	-	-	-	53.1	59.3	73.7

/a 1920; /b 1930; /c 1925; /d 1937/38; /e 1899; /f 1908; /g 1888; /h 1940; /i 1950; /j 1955.

Sources: (1) I_f, I_g, I_m, I_h: Mosk (1980).
(2) TFR, NRR, CBR, CDR: 1875-1940: Taeuber (1958)
1934/41- 1959/61: Keyfitz & Flieger (1968).
(3) q(15), IMR: 1899, 1908: Preston, Keyfitz & Schoen (1972)
1920/24-1935/40: Taeuber (1958)
1939/41 - 1959/61: Keyfitz & Flieger (1968).
(4) School enrollment data: Banks (1971), U.S. Bureau of the Census (1974).
(5) School age population: 1888, 1920-1955: Taeuber (1958)
1899, 1908: Preston, Keyfitz, and Schoen (1972)
1959/61: Keyfitz & Flieger (1968)
1970: United Nations (1979b).

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Table A.6: Coale's Indices of Overall Fertility, Marital Fertility, and Proportions Married

Standard Schedule: Age groups (i)	Births per married Hutterite woman, 1921-1930. (F_i)
15-19	.300
20-24	.550
25-29	.502
30-24	.447
35-39	.406
40-44	.222
45-49	.061

I_f = index of overall fertility

$$= \frac{B_t}{\Sigma F_i w_i}$$

I_h = index of illegitimate fertility

$$\frac{B_t^I}{\Sigma F_i u_i}$$

I_g = index of marital fertility

$$= \frac{B_t^L}{\Sigma F_i m_i}$$

I_m = index of proportions married

$$= \frac{\Sigma F_i m_i}{\Sigma F_i w_i}$$

$$I_f = I_g \cdot I_m + I_h (1 - I_m)$$

B_t = total births at time t in the population studied

B_t^L = legitimate births at time t in the population studied

B_t^I = illegitimate births at time t in the population studied

w_i = total women in the ith age group in the population studied (using five year age groupings)

m_i = total married women in the ith age group in the population studied (using five year age groupings)

u_i = total unmarried women in the ith age group in the population studied (using five year age groupings)

F_i = births per woman in the "standard" population in the ith age interval

Source: Ansley J. Coale, "Factors Associated with the Development of Low Fertility: An Historic Summary," United Nations, *World Population Conference: 1965*, Vol. II (New York: United Nations, 1967), pp. 205-209.

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Appendix Tables B.1 to B.18 /1

(Fertility, Mortality and School Enrollment Data for 18 LDCs)

/1 Source: Data on Crude Birth Rate (CBR), Total Fertility Rate (TFR), Crude Death Rate (CDR) and Life Expectancy at Birth (e^{o}) are from (World Bank, 1983). Enrollment Data are from UNESCO Statistical Yearbook, 1970, 1977 and 1982. For Taiwan, enrollment data for 1960 onwards are from (Republic of China, 1981 and 1982).

Table B.1: Barbados

Year	CBR	TFR	CDR	e^{o}	Gross Enrollment Rate Primary /1	Secondary
1950	32.9	4.1	14.4	54.8	-	-
1955	32.2	4.1	11.9	60.1	-	-
1960	30.7	4.1	10.2	64.3	95	39 /2
1965	26.8	3.7	9.4	66.8	106	61 /2
1970	22.8	3.2	9.0	68.3	108	71 /3
1975	22.0	2.8	8.9	69.5	101	77 /4
1976	-	-	-	-	-	-
1977	-	-	-	-	-	-
1978	-	-	-	-	-	-
1979	-	-	-	-	-	-
1980	22.9	2.6	8.6	70.8	117	85 /3

/1 age (5-10)
/2 age (11-18)
/3 age (11-17)
/4 age (11-16)

Table B.2: Brazil

Year	CBR	TFR	CDR	e^{o}	Gross Enrollment Rate Primary	Secondary
1950	45.3	6.1	15.9	49.8	68 /1	6 /5
1955	44.0	6.1	14.0	52.2	76 /1	8 /5
1960	42.7	6.1	12.9	54.7	95 /2	11 /5
1965	39.3	5.7	11.5	56.9	72 /3	17 /6
1970	35.0	5.0	10.3	58.9	76 /4	24 /7
1975	32.8	4.5	9.3	60.8	87 /4	31 /7
1976	-	-	-	-	-	-
1977	-	-	-	-	-	-
1978	-	-	-	-	-	-
1979	-	-	-	-	-	-
1980	30.9	4.0	8.4	63.1	84 /4	36 /7

/1 age (7-12); /2 age (7-10); /3 age (6-11); /4 age (6-13); /5 age (11-17); /6 age (12-18); /7 age (14-17).

Table B.3: Chile

Year	CBR	TFR	CDR	e^{o}	Gross Enrollment Rate	
					Primary	Secondary
1950	34.0	4.6	13.9	53.1	93 /1	14 /3
1955	36.3	5.0	13.2	55.1	101 /1	21 /3
1960	36.6	5.1	12.3	56.9	109 /1	24 /3
1965	32.8	4.5	10.9	59.1	124 /1	34 /3
1970	28.0	3.7	9.2	62.4	107 /2	39 /4
1975	25.7	3.2	8.2	64.9	118 /2	48 /4
1976	-	-	-	-	-	
1977	-	-	-	-	-	
1978	-	-	-	-	-	
1979	-	-	-	-	-	
1980	25.1	3.0	7.6	67.1	117 /2	55 /4

/1 age (7-12); /2 age (6-13); /3 age (13-18); /4 age (14-17).

Table B.4: Colombia

Year	CBR	TFR	CDR	e^{o}	Gross Enrollment Rate	
					Primary	Secondary
1950	48.3	6.7	19.3	46.5	60	5
1955	46.9	6.7	15.9	50.3	69	7
1960	45.7	6.7	13.6	53.1	77	12
1965	42.3	6.3	11.6	55.9	85	17
1970	36.8	5.4	9.7	58.9	103	25
1975	32.3	4.4	8.6	60.8	114	39
1976	-	-	-	-	-	-
1977	-	-	-	-	-	-
1978	-	-	-	-	-	-
1979	-	-	-	-	-	-
1980	30.0	3.8	7.8	62.9	128 /1	46 /2

/1 age (6-10). In previous years, it is 7-11 years;
/2 age (11-16). In previous years, it is 12-17 years.

Table B.5: Costa Rica

Year	CBR	TFR	CDR	e^{o}	Gross Enrollment Rate	
					Primary	Secondary
1950	47.2	6.5	13.1	55.8	78 /1	7 /4
1955	47.9	6.9	11.6	58.7	96 /1	18 /4
1960	46.8	7.0	9.9	61.6	96 /2	21 /5
1965	41.8	6.4	8.1	64.3	106 /2	24 /5
1970	34.6	5.2	6.5	66.9	110 /3	28 /6
1975	30.8	4.2	5.2	69.8	107 /3	43 /6
1976	-	-	-	-	-	-
1977	-	-	-	-	-	-
1978	-	-	-	-	-	-
1979	-	-	-	-	-	-
1980	30.0	3.6	4.4	72.2	107 /3	48 /6

/1 age (6-11); /2 age (12-17).

Table B.6: Mexico

Year	CBR	TFR	CDR	e^{o}	Gross Enrollment Rate	
					Primary /1	Secondary /2
1950	47.1	6.8	17.7	48.4	62	5
1955	46.3	6.8	14.7	53.1	69	6
1960	45.4	6.8	12.2	57.0	80	11
1965	44.6	6.7	10.8	59.5	92	17
1970	43.4	6.6	9.7	61.3	104	22
1975	40.1	5.9	8.5	63.1	109	35
1976	-	-	-	-	-	-
1977	-	-	-	-	-	-
1978	-	-	-	-	-	-
1979	-	-	-	-	-	-
1980	32.7	5.1	7.2	65.2	120	37

/1 age (6-11); /2 age (12-17).

Table B.7: Hong Kong

Year	CBR	TFR	CDR	e^o	Gross Enrollment Rate	
					Primary	Secondary
1950	35.6	4.3	11.6	60.8	-	-
1955	36.3	4.9	9.6	64.0	61 /1	32 /3
1960	34.5	5.3	7.8	66.7	87 /2	24 /4
1965	27.0	4.6	6.6	68.9	103 /2	34 /4
1970	20.4	3.5	5.9	70.9	117 /1	36 /5
1975	18.3	2.7	5.5	72.6	120 /1	49 /5
1976	-	-	-	-	-	-
1977	-	-	-	-	-	-
1978	-	-	-	-	-	-
1979	-	-	-	-	-	-
1980	18.6	2.2	5.3	74.5	109 /1	62 /5

/1 age (6-11); /2 age (5-10); /3 age (12-17); /4 age (11-17); /5 age (12-18).

Table B.8: India

Year	CBR	TFR	CDR	e^o	Gross Enrollment Rate	
					Primary	Secondary
1950	40.7	5.9	27.6	37.2	28 /1	4 /3
1955	42.8	6.0	24.7	40.2	34 /1	7 /3
1960	43.7	6.0	21.8	43.2	61 /2	10 /4
1965	42.3	5.9	19.0	45.9	74	36
1970	40.0	5.6	16.7	48.1	73	26
1975	37.4	5.3	14.9	49.9	76	26
1976	-	-	-	-	-	-
1977	-	-	-	-	-	-
1978	-	-	-	-	76	28
1979	-	-	-	-	-	-
1980	35.6	4.9	13.6	51.8	-	-

/1 age (6-12); /2 age (5-9); for all years after 1960
/3 age (13-17); /4 age (10-15) for all years after 1960.

Table B.9: Philippines

Year	CBR	TFR	CDR	e^o	Gross Enrollment Rate Primary /1	Secondary /2
1950	50.3	7.3	21.2	45.8	-	-
1955	48.4	7.1	17.8	49.3	91	27
1960	46.7	7.0	14.6	52.8	95	26
1965	45.6	6.8	11.9	56.0	113	41
1970	44.0	6.4	9.8	59.0	108	46
1975	39.5	5.6	8.3	61.1	108	54
1976	-	-	-	-	-	-
1977	-	-	-	-	-	-
1978	-	-	-	-	-	-
1979	-	-	-	-	-	-
1980	34.6	4.7	7.4	62.8	110	63

/1 age (7-12); /2 age (13-16).

Table B.10: Singapore

Year	CBR	TFR	CDR	e^o	Gross Enrollment Rate Primary /1	Secondary /2
1950	45.8	6.5	11.6	59.0	80	8
1955	43.0	6.1	9.6	61.8	94	18
1960	37.8	5.4	7.8	64.5	111	32
1965	29.5	4.2	6.4	66.9	105	45
1970	23.1	3.0	5.4	68.7	106	46
1975	19.2	2.2	5.1	70.2	111	53
1976	-	-	-	-	-	-
1977	-	-	-	-	-	-
1978	-	-	-	-	-	-
1979	-	-	-	-	-	-
1980	17.6	1.8	5.1	71.5	107	55

/1 age (6-11); /2 age (12-17).

Table B.11: Republic of Korea

Year	CBR	TFR	CDR	e^{o}	Gross Enrollment Rate Primary [2]	Secondary [2]
1950	-	-	-	-	83	16
1955	45.3 [1]	5.9	14.4	53.2	89	29
1960	42.7	5.6	13.4	54.4	94	27
1965	35.6	4.8	11.0	57.3	101	35
1970	30.3	4.2	9.1	60.3	103	42
1975	26.2	3.6	8.0	62.8	107	50
1976	-	-	-	-	-	-
1977	-	-	-	-	-	-
1978	-	-	-	-	-	-
1979	-	-	-	-	-	-
1980	23.8	3.0	7.1	65.4	109	80

[1] 1958

[2] age (6-11); [3] age (12-17).

Table B.12: Sri Lanka

Year	CBR	TFR	CDR	e^{o}	Gross Enrollment Rate Primary	Secondary
1950	39.5	5.9	12.3	54.6	-	-
1955	37.6	5.6	10.7	58.5	-	-
1960	35.7	5.3	9.2	62.0	95 [1]	27 [3]
1965	33.2	4.9	8.2	63.9	93 [1]	35 [3]
1970	29.4	4.4	7.5	63.6	99 [2]	47 [4]
1975	27.8	4.0	8.5	64.0	77	48
1976	-	-	-	-	-	-
1977	-	-	-	-	-	-
1978	-	-	-	-	-	-
1979	-	-	-	-	-	-
1980	27.6	3.6	6.1	68.0	100	51

[1] age (5-12); [2] age (6-10) for all years after 1970.

[3] age (13-16); age (11-17) for all years after 1970.

Table B.13: Taiwan, China

Year	CBR	TFR	CDR	e^{o}	Gross Enrollment Rate	
					Primary /2	Secondary /3
1950	46.6/1	6.7/1	9.9/1	57.7/1	79	11
1955	45.3	6.3	8.6	61.6	97	19
1960	39.5	5.7	7.0	64.7	96	30
1965	32.7	4.8	5.5	66.6	97	38
1970	27.2	3.8	4.9	68.7	98	54
1975	23.0	3.0	4.7	70.9	99	66
1976	-	-	-	-	-	-
1977	-	-	-	-	-	-
1978	-	-	-	-	-	-
1979	-	-	-	-	-	-
1980	23.4	2.7	4.8	72.4	100	80

/1 1952
/2 age (6-11)
/3 age (10-17)

Table B.14: Thailand

Year	CBR	TFR	CDR	e^{o}	Gross Enrollment Rate	
					Primary /1	Secondary
1950	-	-	-	-	76	-
1955	-	-	-	-	79	-
1960	43.6	6.4	14.9	52.3	83	12
1965	42.4	6.3	12.6	55.4	78	14
1970	39.7	5.8	10.8	57.9	83	17
1975	34.5	4.9	9.2	60.2	84	26
1976	-	-	-	-	-	-
1977	-	-	-	-	-	-
1978	-	-	-	-	-	-
1979	-	-	-	-	-	-
1980	30.1	4.0	7.9	62.6	96	29

/1 age (7-13); /2 age (14-18).

Table B.15: Egypt

Year	CBR	TFR	CDR	e^{o}	Gross Enrollment Rate Primary /1	Secondary /2
1950	45.4	6.2	22.4	41.1	41	17
1955	44.4	6.1	20.8	43.6	52	16
1960	43.5	6.1	19.0	46.1	66	16
1965	41.7	5.9	17.0	48.6	75	26
1970	38.4	5.6	15.1	51.3	72	34
1975	37.6	5.3	13.6	54.3	73	43
1976	-	-	-	-	-	-
1977	-	-	-	-	-	-
1978	-	-	-	-	-	-
1979	-	-	-	-	-	-
1980	36.6	4.9	12.1	56.6	76	52

/1 age (6-11)
/2 age (12-17)

Table B.16: Ghana

Year	CBR	TFR	CDR	e^{o}	Gross Enrollment Rate Primary	Secondary
1950	50.2	7.0	24.2	39.6	32	1
1955	50.2	7.0	22.4	42.2	52	6
1960	50.2	7.0	20.3	44.8	59	8
1965	50.2	7.0	18.2	47.4	79	15
1970	50.2	7.0	16.8	49.9	64 /1	14 /2
1975	49.8	7.0	15.5	52.2	70	36
1976	-	-	-	-	-	-
1977	-	-	-	-	-	-
1978	-	-	-	-	71	36
1979	-	-	-	-	-	-
1980	49.4	7.0	13.7	54.5	-	-

/1 Before 1970, age is (6-11), after 1970, it is (6-15).
/2 Before 1970, age is (12-19), after 1970, it is (16-19).

Table B.17: Kenya

Year	CBR	TFR	CDR	e^{o}	Gross Enrollment Rate	
					Primary	Secondary
1950	54.7	8.0	27.7	36.3	-	-
1955	54.7	8.0	25.6	38.8	32 /1	1 /3
1960	54.7	8.0	23.6	41.3	47 /2	2 /4
1965	54.7	8.0	20.8	44.8	54	4
1970	54.7	8.0	17.8	48.7	61	9
1975	54.7	8.0	15.4	51.9	100	13
1976	-	-		-	-	-
1977	-	-		-	-	-
1978	-	-		-	99	18
1979	-	-		-	-	-
1980	54.7	8.0	13.3	55.3	-	-

/1 age (6-12); /2 age (5-11) after 1960.
/3 age (13-18); /4 age (12-17) after 1960.

Table B.18: Tunisia

Year	CBR	TFR	CDR	e^{o}	Gross Enrollment Rate	
					Primary /1	Secondary /2
1950	-	-	-	-	35	8
1955	-	-	-	-	47	9
1960	48.8	7.1	21.0	48.1	66	12
1965	46.1	7.0	17.7	51.2	91	16
1970	40.6	6.5	14.6	54.2	101	23
1975	36.0	5.9	11.2	57.2	97	21
1976	-	-	-	-	-	-
1977	-	-	-	-	-	-
1978	-	-	-	-	-	-
1979	-	-	-	-	-	-
1980	34.4	5.3	9.1	60.2	103	27

/1 age (6-11); /2 age (12-18).

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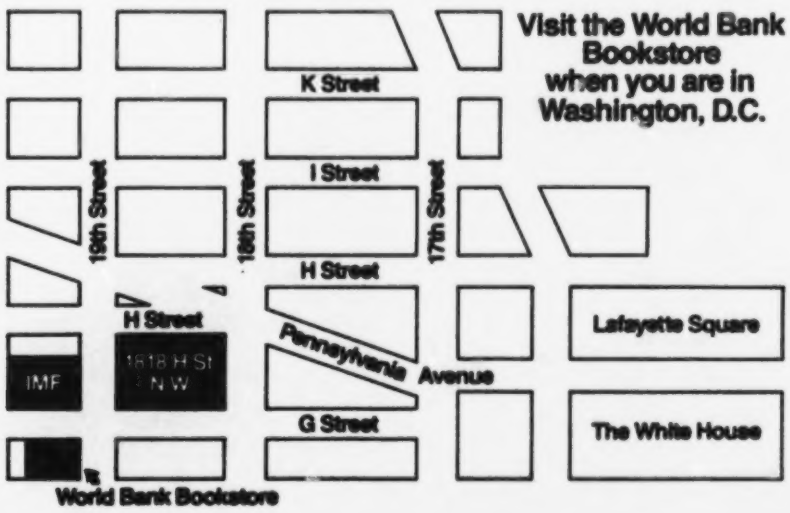

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ISSN 0253-2115/ISBN 0-8213-0450-X